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THESIS

THE RELATIONSHIP BETWEEN OPERATIONAL GRAPHICS
AND BATTLEFIELD SUCCESS

by

Charles A. Stafford

September, 1990

Thesis Co-Advisors:

Robert R. Read
David A. Dryer

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The Relationship Between Operational Graphics and
Battlefield Success

by

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

This thesis analyzes deliberate attack missions conducted at the U.S. Army National Training Center (NTC) and evaluates the relationship between the operational graphics used and three unit performance measures of effectiveness (MOE). A methodology for categorizing and evaluating operational graphics is developed along with frequency of operational graphics usage information. A correlation between unit performance and operational graphics is established by comparing the graphics evaluations to the measures of effectiveness. Discriminant data analysis techniques attempting to further define a causal relationship proved inconclusive due to observation sample size and unquantified concomitant variables.

The methodology and analysis contained in this thesis have application to both the creation of training standards for improvement of unit performance, and the evaluation of current operational graphics doctrine. Included within the research are descriptions of the NTC environment, Combat Training Center Archive, battalion task force organization, the use of operational graphics to portray deliberate attack missions, and the task force deliberate attack.

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I. INTRODUCTION

A. BACKGROUND

Since Fort Irwin's reactivation in the late seventies and early eighties, The National Training Center (NTC), located in the Mojave desert in southern California, has served as the principle training area for tank and mechanized infantry units stationed in the continental United States. The missions of NTC are twofold. The primary mission is to prepare units for war through tough, realistic training. The secondary mission is to serve as a data source for training, doctrine, organization, and equipment improvements.

The focus of training at NTC is at the battalion task force level. Every aspect of combat operations is evaluated in all doctrinal mission areas. Deploying units face a highly trained and motivated opposing force which replicates a Soviet-equipped enemy of up to regimental size.

The Operations Group at NTC oversees the tactical environment to maintain training realism and to provide feedback to deploying units for the improvement of unit performance. This feedback is done through the analysis of seven battlefield operating systems (BOS) which include: command and control; maneuver; fire support; intelligence; air defense; mobility, countermobility, and survivability; and combat service support.

B. PURPOSE AND SCOPE

Within the command and control BOS, an important component of battlefield success, both at NTC and in actual combat is a well thought out, well executed tactical plan. This plan takes the form of combat orders, the importance of which is stated in the following:

In order to fight, commanders and their staffs must issue instructions to subordinates. They must communicate how they want operations to be conducted. Instructions or orders may be issued orally or in writing or by a combination of both. They may be issued in person or by electronic means. Words may be used as the principal means to communicate instructions, or sometimes only graphics are used to represent the intent of the commander. As a general rule, both are used. One complements the other. In any case, a common language of operational terms and military symbols is necessary so instructions can be communicated rapidly and with a minimum risk of misunderstanding. [Ref. 1; p. iii]

Observer Controllers (OCs) at NTC have noted a wide variation in the use of operational graphics in support of tactical plans among deploying units. Deploying units

also vary in their ability to successfully execute assigned tactical missions. This has led to the following question. Is there a relationship between battlefield success and the operational graphics which were used during a mission?

The intuitive answer to this question is yes, however; analysis in this area has been limited to subjective evaluations and individual opinions. The purpose of this thesis is to present a methodology for evaluating operational graphics, and then apply this same methodology in an attempt to discover the relationship between operational graphics and unit performance. Analysis in this area may yield training standards which can then be used to improve unit performance. Additionally, the research conducted may provide insights for the revision of FM 101-1-5, *Operational Terms and Graphics*, presently scheduled for 1991.

The scope of this thesis is limited by the following constraints and assumptions:

- Missions evaluated were conducted in a specific environment with limited types of terrain.
- Missions were conducted by only armor and mechanized infantry task forces.
- Only selected deliberate attack missions conducted between 1986 and 1990 were evaluated.
- The force data found in the unit take home packages is assumed to be accurate for the missions which were evaluated.

Any use of the analysis results of this thesis should keep these constraints in mind to avoid arriving at inaccurate or unfounded conclusions.

C. PROBLEM DESCRIPTION AND HYPOTHESIS

In order to evaluate the relationship between operational graphics and unit performance, measures must be developed to quantify each variable. For operational graphics this includes recording the type, quantity, and quality of symbols used. Enumerating the type and quantity of symbols used for a given operation is a relatively easy process. On the other hand, there is no established methodology for qualitatively analyzing these same symbols. An evaluation procedure is presented in Chapter IV to handle this problem.

Unit performance is equally difficult to quantify. There are many factors which influence unit performance. Some of these factors can be readily taken from battle results in the form of measures of effectiveness MOEs, while other factors may prove to be intangible. The approach of this thesis is to focus on the MOEs while keeping in mind their limitations in totally describing unit performance (Chapter III).

Once both unit performance and operational graphics have been adequately quantified, the following hypothesis will be evaluated for validity: Given a task force deliberate attack conducted under NTC conditions, there exists a relationship between the operational graphics used and how a unit performed during that mission.

II. DATA COLLECTION

A. DATA ENVIRONMENT

1. National Training Center

The National Training Center (NTC) is located in the Mojave Desert at Fort Irwin, halfway between Los Angeles, California and Las Vegas, Nevada. The Fort Irwin reservation covers approximately 640,000 acres of land; roughly two-thirds of which is navigable by the tracked and wheeled vehicles of the United States Army. For training purposes, NTC is divided into three corridors along natural terrain boundaries. This is shown in Figure 1 on page 5. The northern corridor is principally used for live fire exercises, while the central and southern corridors are exclusively used for maneuver training.

NTC has two primary missions. The first is to provide tough, realistic combined arms training at the battalion level. The second mission is to provide a data source for training, doctrine, organization, and equipment improvements [Ref. 2: p. 13]. Training is conducted on a rotational basis, with 14 rotations per fiscal year. The forces involved in each rotation vary; however, most often they consist of a brigade headquarters, two armor or mechanized infantry battalions, an artillery battalion, and a support battalion. These units deploy to NTC by air, rail and convoy from almost every major Army installation within the continental United States. The opposing forces (OPFOR) arrayed against these deploying units are elements of the 177th Armor Brigade.

The OPFOR replicates Soviet ground forces from a motorized rifle company up to a motorized rifle regiment. A concise description of these forces and their equipment can be found in [Ref. 2: pp. 15-16]. The OPFOR has several significant advantages over deploying units. As a tenant unit of Fort Irwin, the OPFOR is exceptionally familiar with the terrain in which maneuver training is conducted. This knowledge is further enhanced by the battle experience which is gained through repeated battles over the same general pieces of terrain.

2. Mechanized and Armor Task Forces

The units deploying for training at NTC are often referred to as the Blue Force. Each of the Blue Force battalions is task organized to form two battalion task forces. A battalion task force is task organized by combining tank and mechanized infantry companies under a single battalion commander to conduct specific operations

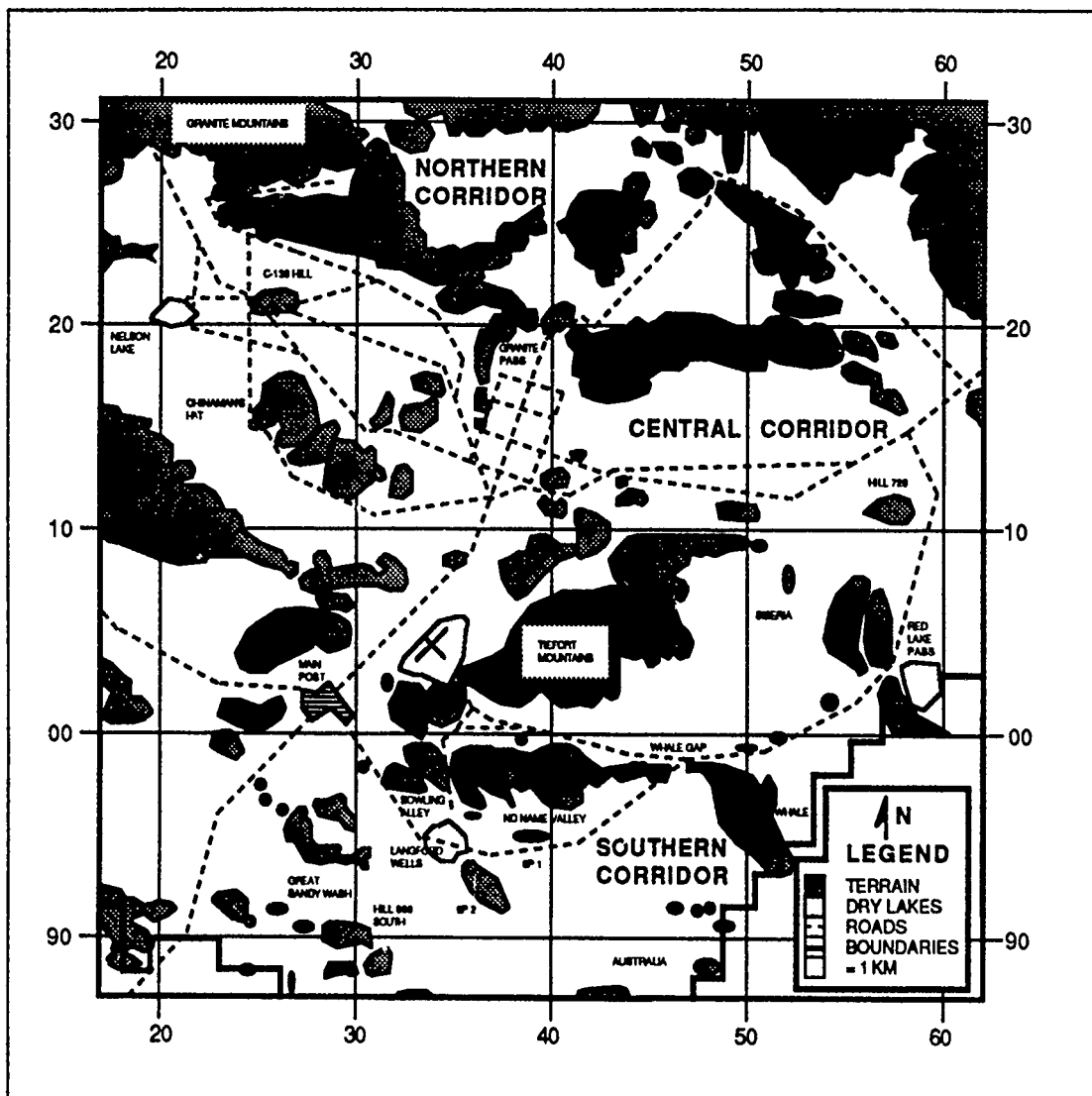


Figure 1. National Training Center Schematic

[Ref. 1: p. 1-9]. A battalion task force usually consists of four or five maneuver companies. These companies can be mixed in varying proportions of armor, mechanized infantry, or anti-armor companies. An example of a mechanized infantry task force is shown in Figure 2 on page 6. Unit symbols are used to represent each level of organization.

3. NTC Rotation Phases

Typical NTC rotations are separated into three phases. Each task force conducts battalion force-on-force, battalion live fire, and brigade force-on-force operations

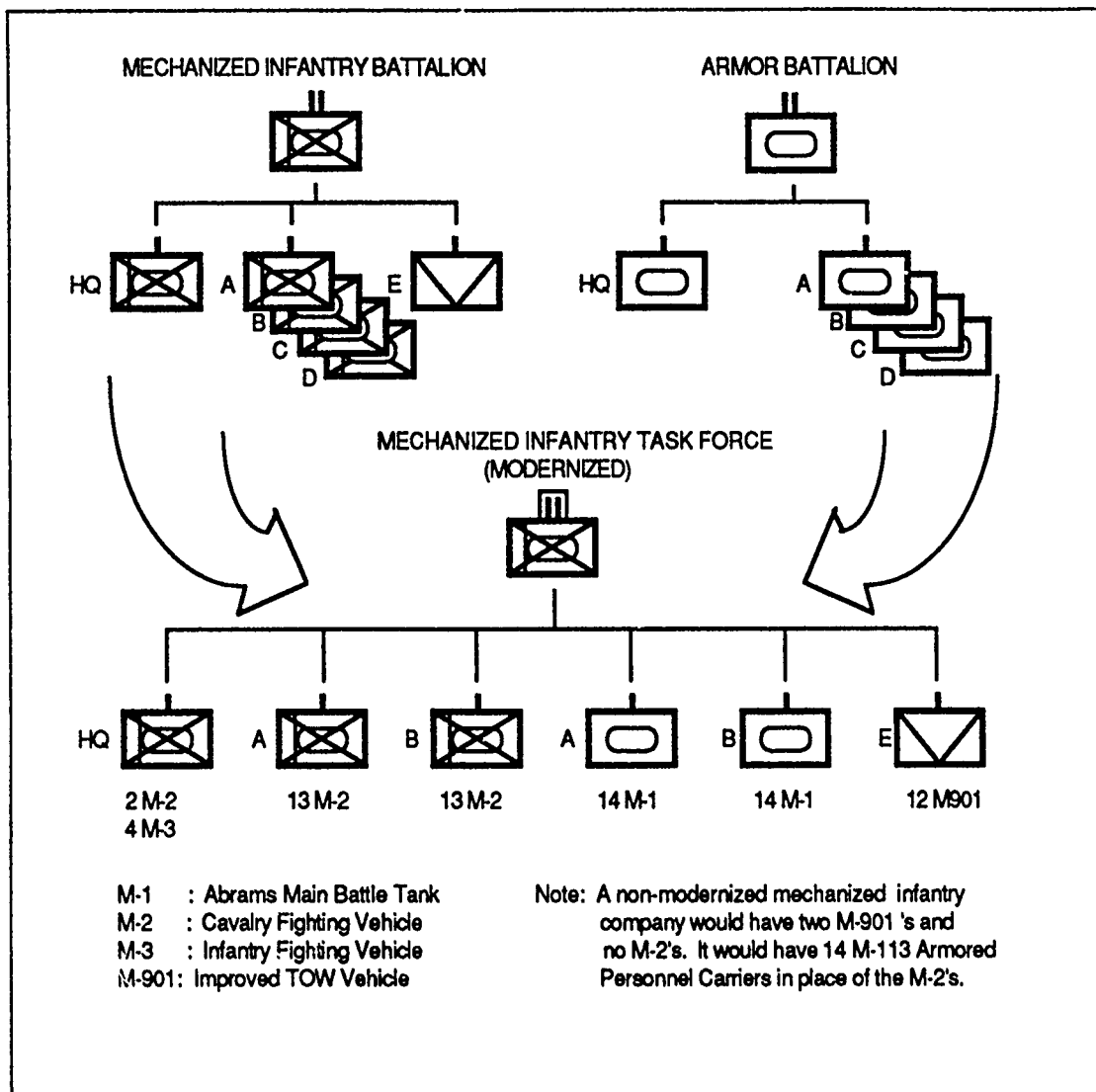


Figure 2. Mechanized Infantry Task Force

over a 14 day period. The sequence of these phases may vary, however; Table 1 on page 7 is representative of a typical rotation. Definitions for the specific missions can be found in Appendix A.

Table 1. TYPICAL NTC ROTATION

TRAINING DAY	ARMOR TASK FORCE MISSION	MECHANIZED TASK FORCE MISSION
T-2 T-1	Arrive / Draw Equipment Deploy to Training	
	FORCE-ON-FORCE	LIVE FIRE
1	Movement to Contact	Live Fire Preparation
2	Deliberate Attack	Live Fire Preparation
3	Prepare Defense	Defense
4	Defense in Sector	Movement to Contact
5	Deliberate Attack	Prepare Battle Position
	LIVE FIRE	FORCE-ON-FORCE
6	Live Fire Preparation	Defend a Battle Position
7	Live Fire Preparation	Defend a Battle Position
8	Defense	Deliberate Attack
9	Counterattack	Deliberate Attack
10	Prepare Battle Position	Prepare Defense
	BRIGADE FORCE-ON-FORCE	
11	Prepare Battle Position	Defense in Sector
12	Defend Battle Position	Counterattack
13	Deliberate Attack	Deliberate Attack
14	Deliberate Attack	Deliberate Attack
	END OF TRAINING	
T+1	Maintenance	
T+2	Equipment Turn-in	
T+3	Equipment Turn-in	
T+4	Redeployment to Home Station	

B. DATA COLLECTION FOCUS

1. General

In an effort to focus in on the influence of operational graphics on unit performance, the available data was screened against a specific set of attributes. The rationale for each of these screens is explained below.

2. Daylight Deliberate Attacks

The task force mission which was selected for evaluation was the deliberate attack. A deliberate attack is an attack planned and carefully coordinated with all concerned elements based on a thorough reconnaissance, evaluation of all intelligence and relative combat strength, analysis of various courses of action, and other factors

affecting the situation [Ref. 1: p. 1-8]. The process of planning and executing a deliberate attack provides a wealth of varied operational graphics for evaluation. A majority of deploying units must execute this mission during an NTC rotation, thereby providing a large sample size to draw from. The reason for further restricting the data set to daylight deliberate attacks is based on the fact that different symbols are used for night operations due to limited visibility.

3. Operation Overlays

Only those missions for which an operation overlay could be found were evaluated. While it is possible to find other records of the operational graphics used by a unit, these records are transcriptions and often incomplete. An example of this type of transcription is the computer generated graphics which are presented on the after action review video tapes. The completeness of these graphics was inconsistent due to the requirement to display only those portions of the plan necessary to describe what had or had not occurred during a given battle. Supporting overlays such as those produced for intelligence, combat service support, and fire support were not evaluated.

4. Battalion Force-on-Force Battles

As can be seen in Table 1 on page 7, there may be several deliberate attacks conducted during an NTC rotation. Only deliberate attacks from the battalion force-on-force training period were selected for evaluation. Additionally, if a task force conducted more than one deliberate attack during this phase, only the first mission was collected. The selection of the first deliberate attack conducted by a unit during battalion force-on-force operations provided the most accurate picture of the level of training of the unit. Missions conducted during brigade force-on-force operations were eliminated because of the influence of the higher headquarters on the task force graphics.

5. Unit Types

The sample population was further restricted by the type of units that were evaluated. Only deliberate attacks conducted by armor or mechanized infantry task forces were included in the data set. Armored cavalry units, motorized infantry units, and aviation units were eliminated due to the large differences in equipment and organization. Both modernized units (equipped with the M-1 Main Battle Tank and M2/3 Bradley Fighting Vehicle) and non-modernized units (equipped with the M113 Armored Personnel Carrier and M60A3 Tank) were included in the data set. Additionally, deliberate attacks conducted during Heavy/Light rotations were also included when these attacks involved a mechanized infantry or armor task force. Deliberate attacks by light

infantry task forces were excluded from evaluation for equipment and organizational differences.

6. Southern Corridor Battles

Only deliberate attacks conducted in the southern corridor of NTC were selected in an effort to minimize the effect of terrain on unit performance. It was not possible to further restrict the area of study to a more specific maneuver area due to quantity of data available.

C. DATA SOURCES

1. ARI-POM

a. Mission

The data was collected at the Combat Training Center (CTC) archive at the Army Research Institute - Presidio of Monterey (ARI-POM). The mission of the CTC archive is to provide users the ability to exploit data derived from CTC experience for the improvement of Doctrine, Training, Organization, Material, and Leadership (DTOML) [Ref. 3: Tab A].

b. Facilities

The CTC archive has both digital and non-digital data. The digital database includes unit take home packages (containing a written evaluation of what the unit did), battlefield events, and battle replay. The digital data may be accessed through a VAX computer network or through personal computer. Non-digital data sources include written copies of the unit take home packages, training and evaluation outlines, operation orders and overlays, after action review (AAR) video tapes, and radio recordings of 80 channels. Nearly everything that a deploying unit does during an NTC rotation is recorded for future analysis.

The three primary facilities of the CTC Archive are the digital data archive, non-digital data archive, and the Combat Operations Research Facility (CORF). The CORF is visited by agencies throughout the Army for analysis of DTOML issues, and contains all of the equipment necessary to combine the varied data sources into a coherent study.

The data which was used in this thesis was taken entirely from the non-digital data archive. The primary data sources exploited in this area were operation orders and overlays, unit take home packages, and video AAR tapes.

2. Operation Orders

The operation orders were the actual orders issued by the Blue Force units during their rotations. These orders are maintained in chronological folders and envelopes by rotation.

3. Operation Overlays

The operation overlays were found in two formats. In roughly 25% of the missions evaluated, the actual acetate overlay was found. These overlays were rolled up, labelled, and stacked next to the operation order files. The remainder of the overlays evaluated were paper copies produced by running the original acetate overlay through a blue print machine at NTC. The paper overlays were placed in the operation order files. These overlays had to be traced onto acetate in order to place them over the NTC maps for evaluation.

4. Unit Take Home Packages

The unit take home packages are maintained in loose-leaf binders and are stored by rotation. The take home package is broken down into a general summary, mission statements and commander's intent, lessons learned, and statistical analysis. Information taken from the statistical analysis section included task force battle losses, company/team battle losses, weapons systems causing OPFOR casualties, and battle loss ratios.

5. AAR Tapes

The AAR video tapes are also stored chronologically by rotation. They were viewed in order to gain an understanding of each evaluated Blue Force mission and to clarify the type and purpose of the graphics utilized. These tapes focus on, but are not limited to, operation orders, initial contact with the OPFOR, lessons learned, and battle summaries.

D. SELECTED DATA

In an effort to examine the most current operations at NTC, data was collected in reverse chronological order. Starting with rotation 90-4 (January 1990), each rotation was screened until a total of 30 observations were obtained. The number of observations was set at 30 based on requirements for statistical significance and time limitations.

1. Data Reduction

After eliminating brigade and multiple deliberate attacks by the same task force, a total of 88 possible missions had to be screened before 30 complete observations were found. The breakdown of the 58 missions eliminated are listed below.

- 12 Incorrect mission type (Night and Hasty attacks)
- 26 Deliberate attacks with missing operation overlays
- 10 Incorrect unit type
- 10 Deliberate attacks outside the southern corridor

It should be noted that the non-digital data archive was undergoing a period of reorganization during the time that the data was collected. There has been a lack of standardization both in what non-digital data is to be sent to the archive from the CTC, as well as what data is to be maintained in the archive and for how long. This lack of standardization has resulted in a loss of information in some areas. The fact that 30% of the operation overlays were missing is an example of this loss.

2. Mission Listing

The missions selected for analysis are shown in the Table 2 on page 12. Despite the fact that a large number of observations were eliminated in the data reduction process, the final sample is representative of the three year period covered. Almost every armor and mechanized infantry division and separate brigade is represented. An even distribution of modernized and non-modernized units can be found along with a Army National Guard, or Roundout, unit. Every month of the year is represented except for May.

Table 2. DELIBERATE ATTACK MISSION LIST

NO.	ROT	DATE	TASK FORCE	NTC LOCATION	ROTATION TYPE
1	87-03	28 Nov 86	Armor	Australia	Non-Modernized
2	87-03	02 Dec 86	Mech	Siberia	Non-Modernized
3	87-05	07 Feb 87	Armor	Australia	Modernized
4	87-06	03 Mar 87	Armor	Australia	Non-Modernized
5	87-06	04 Mar 87	Armor	Australia	Non-Modernized
6	87-07	28 Mar 87	Mech	Australia	Modernized
7	87-07	31 Mar 87	Armor	Red Lake Pass	Modernized
8	87-08	21 Apr 87	Armor	Australia	Non-Modernized
9	87-12	17 Aug 87	Mech	Red Lake Pass	Non-Modernized
10	87-14	22 Sep 87	Mech	Bowling Alley	Non-Modernized
11	87-14	29 Sep 87	Armor	Whale Gap	Non-Modernized
12	88-02	13 Nov 87	Mech	Hill 909 North	Non-Modernized
13	88-05	07 Feb 88	Mech	Hill 909 South	Modernized
14	88-06	29 Feb 88	Mech	Australia	Heavy/Light (NM)
15	89-01	16 Oct 88	Armor	Whale Gap	Heavy/Light (NM)
16	89-01	19 Oct 88	Mech	Hill 909 North	Heavy/Light (NM)
17	89-02	08 Nov 88	Mech	Whale Gap	Non-Modernized
18	89-02	14 Nov 88	Armor	OP 2	Non-Modernized
19	89-03	01 Dec 88	Armor	Great Sandy Wash	Heavy/Light (M)
20	89-04	11 Jan 89	Armor	Whale Gap	Modernized
21	89-10	05 Jun 89	Mech	Red Lake Pass	Non-Modernized
22	89-10	10 Jun 89	Armor	Red Lake Pass	Roundout (NM)
23	89-11	11 Jul 89	Armor	Red Lake Pass	Modernized
24	89-12	06 Aug 89	Armor	Langford Wells	Heavy Light (M)
25	89-12	10 Aug 89	Mech	OP 1	Heavy/Light (M)
26	89-13	30 Aug 89	Armor	Red Lake Pass	Non-Modernized
27	89-13	02 Sep 89	Mech	No Name Valley	Non-Modernized
28	89-14	23 Sep 89	Armor	Whale Gap	Modernized
29	89-14	26 Sep 89	Mech	OP 1	Modernized
30	90-04	16 Jan 90	Armor	OP 1	Modernized

3. Mission Statistics

Of the 30 deliberate attacks evaluated 17 were conducted by armor and 13 by mechanized infantry. 12 were conducted by modernized and 18 by non-modernized units. Six of the missions were conducted during heavy, light rotations. The breakout by calender years was two in 1986, ten in 1987, seven in 1988, ten in 1989, and one in 1990.

III. UNIT PERFORMANCE EVALUATION

A. GENERAL

There are many components which contribute to unit performance. Some factors, such as starting force ratios, number of friendly systems surviving, and number of enemy systems destroyed are easy to quantify. Factors such as leadership, experience, training, and motivation are more elusive. In an ideal analysis of operational graphics and unit performance all contributing variables would be quantified and included. The scope of this thesis does not permit such an evaluation. As a result, only non-subjective measures were used in the evaluation of unit performance. This evaluation was done by looking at starting force ratios, and three quantifiable measures of effectiveness (MOEs).

Many different systems participate in a task force deliberate attack from the individual soldier up to the main battle tank. The most reliable data available from the statistics portion of the take home package has to do with major tank killing systems. For these systems, the exact number of systems starting, destroyed, and surviving is recorded by system type. The MOEs are derived from these numbers. For Blue Force units the systems considered were tanks, Bradley Fighting Vehicles (BFV), and Tube-launched, Optically-tracked, Wire-guided (TOW) missile carriers. Tanks and BMPs (the Soviet equivalent to the BFV) were considered for the OPFOR.

B. FORCE RATIO

Army doctrine states that deliberate attacks are ideally conducted with a minimum force ratio of three friendly systems to every enemy system. The force ratios are displayed in Table 3 on page 14. The force ratio for each observation i , was calculated using the following formula:

$$FORCE\,RATIO_i = \frac{BLUE(Tanks_i + BFV_s_i + TOW_s_i) \text{ Starting}}{OPFOR(Tanks_i + BMP_s_i) \text{ Starting}}$$

Table 3. DELIBERATE ATTACK FORCE RATIOS

NO.	ROT	DATE	BLUE			OPFOR		BLUE TOTAL	OPFOR TOTAL	FORCE RATIO
			TNK	BFV	TOW	TNK	BMP			
1	87-03	28 Nov 86	28	0	9	4	10	37	14	2.64
2	87-03	02 Dec 86	22	0	15	4	11	37	15	2.47
3	87-05	07 Feb 87	26	21	0	8	15	47	23	2.04
4	87-06	03 Mar 87	28	0	9	4	12	37	16	2.31
5	87-06	04 Mar 87	25	0	8	4	12	33	16	2.06
6	87-07	28 Mar 87	23	28	10	8	16	61	24	2.54
7	87-07	31 Mar 87	25	28	0	8	16	53	24	2.21
8	87-08	21 Apr 87	40	0	3	4	15	43	19	2.26
9	87-12	17 Aug 87	22	0	11	4	14	33	18	1.83
10	87-14	22 Sep 87	27	0	17	4	9	44	13	3.38
11	87-14	29 Sep 87	29	0	7	4	12	36	16	2.25
12	88-02	13 Nov 87	24	0	15	8	20	39	28	1.39
13	88-05	07 Feb 88	25	31	10	8	16	66	24	2.75
14	88-06	29 Feb 88	24	0	18	4	14	42	18	2.33
15	89-01	16 Oct 88	26	0	10	12	10	36	22	1.64
16	89-01	19 Oct 88	24	0	13	13	23	37	36	1.03
17	89-02	08 Nov 88	25	0	17	12	23	42	35	1.20
18	89-02	14 Nov 88	24	0	9	12	18	33	30	1.10
19	89-03	01 Dec 88	24	26	0	16	29	50	45	1.11
20	89-04	11 Jan 89	38	16	0	22	38	54	60	0.90
21	89-10	05 Jun 89	23	0	11	8	10	34	18	1.89
22	89-10	10 Jun 89	26	0	10	12	24	36	36	1.00
23	89-11	11 Jul 89	32	20	0	21	38	52	59	0.88
24	89-12	06 Aug 89	28	20	0	21	24	48	45	1.07
25	89-12	10 Aug 89	22	25	11	6	18	58	24	2.42
26	89-13	30 Aug 89	38	0	0	19	32	38	51	0.75
27	89-13	02 Sep 89	34	0	0	18	27	34	45	0.76
28	89-14	23 Sep 89	24	28	0	13	21	52	34	1.53
29	89-14	26 Sep 89	11	41	8	19	34	60	53	1.13
30	90-04	16 Jan 90	20	22	3	15	16	45	31	1.45

The mean force ratio was 1.74 to 1. The range of values was from .75 to 1 up to 3.38 to 1. There are several reasons for this wide range of values. The most important reason was a change in OPFOR representation which occurred in 1987.

The equivalent OPFOR organization to the task force is the Motorized Rifle Battalion (MRB). The OPFOR MRB has a total of 45 tank killing systems divided up into 13 tanks and 32 BMPs. The MRB has three Motorized Rifle Companies (MRC), each with four tanks and ten BMPs. The MRB normally defends with two MRCs forward

and the third in reserve. Up until 1987, an attacking task force would only face one independent MRC, or an MRB with two notional (imaginary) MRC's. This philosophy was changed in order to more realistically portray the Soviet threat. Attacking task forces would now face the entire MRB, and be told to focus the attack on one MRC. Very few units have been successful in locating and isolating their efforts on one MRC, and more often than not end up taking on the entire MRB. This has lead to an increase in the number of enemy systems which the task force must fight, and thereby decreases the force ratio.

Other factors which impact on the force ratio include the composition of the Blue Force, the maintenance posture of the units (vehicles which are inoperative do not participate), and the area of operations for the mission.

C. MOE 1: DESTROY MOE

MOE 1, the Destroy MOE, measures the percentage of OPFOR destroyed. The values for MOE 1 are shown in Table 4 on page 16. The equation used to calculate MOE 1 for each observation i is:

$$MOE 1_i = \frac{OPFOR (Tanks_i + BMPs_i) Destroyed}{OPFOR (Tanks_i + BMPs_i) Starting} \times 100$$

Table 4. OPFOR MISSION DATA AND DESTROY MOE

NO.	ROT	DATE	TANK		BMP		MOE 1 (%)
			Start	Lost	Start	Lost	
1	87-03	28 Nov 86	4	2	10	8	71.43
2	87-03	02 Dec 86	4	0	11	6	40.00
3	87-05	07 Feb 87	8	7	15	8	65.22
4	87-06	03 Mar 87	4	2	12	9	68.75
5	87-06	04 Mar 87	4	2	12	9	68.75
6	87-07	28 Mar 87	8	8	16	16	100.00
7	87-07	31 Mar 87	8	4	16	12	66.67
8	87-08	21 Apr 87	4	1	15	7	42.11
9	87-12	17 Aug 87	4	3	14	13	88.89
10	87-14	22 Sep 87	4	4	9	8	92.31
11	87-14	29 Sep 87	4	4	12	11	93.75
12	88-02	13 Nov 87	8	1	20	4	17.86
13	88-05	07 Feb 88	8	2	16	6	33.33
14	88-06	29 Feb 88	4	4	14	8	66.67
15	89-01	16 Oct 88	12	8	10	3	50.00
16	89-01	19 Oct 88	13	4	23	9	36.11
17	89-02	08 Nov 88	12	4	23	17	60.00
18	89-02	14 Nov 88	12	5	18	11	53.33
19	89-03	01 Dec 88	16	4	29	7	24.44
20	89-04	11 Jan 89	22	5	38	9	23.33
21	89-10	05 Jun 89	8	3	10	7	55.56
22	89-10	10 Jun 89	12	5	24	14	52.78
23	89-11	11 Jul 89	21	7	38	9	27.12
24	89-12	06 Aug 89	21	2	24	4	13.33
25	89-12	10 Aug 89	6	6	18	16	91.67
26	89-13	30 Aug 89	19	6	32	10	31.37
27	89-13	02 Sep 89	18	1	27	5	13.33
28	89-14	23 Sep 89	13	7	21	16	67.65
29	89-14	26 Sep 89	19	3	34	5	15.09
30	90-04	16 Jan 90	15	3	16	4	22.58

A mean of 51.78% of the OPFOR was destroyed across the 30 missions. The range of values was from 13.33% to 100%.

D. MOE 2: SURVIVAL MOE

MOE 2, the Survival MOE, measures the percentage of Blue Force surviving. This is analogous to how well the Blue Force protected its own force during the attack.

The following equation was used to calculate MOE 2 for each observation i :

$$MOE 2_i = \frac{BLUE(Tanks_i + BFVs_i + TOWs_i) \text{ Surviving}}{BLUE(Tanks_i + BFVs_i + TOWs_i) \text{ Starting}} \times 100$$

These values are displayed in Table 5.

Table 5. BLUEFORCE MISSION DATA AND SURVIVAL MOE

NO.	ROT	DATE	TANK		IFV		TOW		MOE 2 (%)
			Start	Lost	Start	Lost	Start	Lost	
1	87-03	28 Nov 86	28	19	0	0	9	4	37.84
2	87-03	02 Dec 86	22	18	0	0	15	0	51.35
3	87-05	07 Feb 87	26	15	21	20	0	0	25.53
4	87-06	03 Mar 87	28	21	0	0	9	5	29.73
5	87-06	04 Mar 87	25	18	0	0	8	3	36.36
6	87-07	28 Mar 87	23	16	28	22	10	7	26.23
7	87-07	31 Mar 87	25	25	28	21	0	0	13.21
8	87-08	21 Apr 87	40	37	0	0	3	1	11.63
9	87-12	17 Aug 87	22	21	0	0	11	3	27.27
10	87-14	22 Sep 87	27	22	0	0	17	10	27.27
11	87-14	29 Sep 87	29	26	0	0	7	2	22.22
12	88-02	13 Nov 87	24	22	0	0	15	5	30.77
13	88-05	07 Feb 88	25	14	31	27	10	4	31.82
14	88-06	29 Feb 88	24	19	0	0	18	5	42.86
15	89-01	16 Oct 88	26	24	0	0	10	8	11.11
16	89-01	19 Oct 88	24	17	0	0	13	7	35.14
17	89-02	08 Nov 88	25	25	0	0	17	11	14.29
18	89-02	14 Nov 88	24	21	0	0	9	7	15.15
19	89-03	01 Dec 88	24	22	26	18	0	0	20.00
20	89-04	11 Jan 89	38	38	16	16	0	0	0.00
21	89-10	05 Jun 89	23	23	0	0	11	9	5.88
22	89-10	10 Jun 89	26	23	0	0	10	8	13.89
23	89-11	11 Jul 89	32	28	20	18	0	0	11.54
24	89-12	06 Aug 89	28	27	10	12	0	0	2.50
25	89-12	10 Aug 89	22	16	25	15	11	8	32.76
26	89-13	30 Aug 89	38	37	0	0	0	0	2.63
27	89-13	02 Sep 89	34	33	0	0	0	0	2.94
28	89-14	23 Sep 89	24	20	28	26	0	0	11.54
29	89-14	26 Sep 89	11	9	41	34	8	4	21.67
30	90-04	16 Jan 90	20	20	22	13	3	1	24.44

Over the 30 battles, the mean number of Blue Force surviving was 21.32%. The values ranged from no survivors up to 42.86%.

E. DELIBERATE ATTACK MOE

In a deliberate attack, the commander is concerned with both preserving his forces and destroying the enemy. Depending on whether he is told to seize, secure, or clear an objective, the commander may place more emphasis on one area or the other. For the purposes of this analysis, preservation of the force and the destruction of the enemy were given equal weight. The Deliberate Attack MOE, MOE 3, is an average of the Destroy MOE (MOE 1) and the Survival MOE (MOE 2):

$$MOE 3_i = \frac{Enemy\ Destroyed_i + Friendly\ Survived_i}{2}$$

The results of these calculations can be found in Table 6 on page 19. The range of scores for MOE 3 were from 7.92 to 63.11. The mean score was 36.55. With the deliberate attack MOE, the score of 50 can be viewed as a break point. By attaining a score above 50, the Blue Force has done better than the OPFOR at destroying enemy and friendly survival. A score below 50 indicates a better overall OPFOR performance in the above areas.

Table 6. DELIBERATE ATTACK MOE

NO.	ROT	DATE	FORCE RATIO	DESTROY MOE 1	SURVIVE MOE 2	DEL ATK MOE 3
1	87-03	28 Nov 86	2.64	71.43	37.84	54.63
2	87-03	02 Dec 86	2.47	40.00	51.35	45.68
3	87-05	07 Feb 87	2.04	65.22	25.53	45.37
4	87-06	03 Mar 87	2.31	68.75	29.73	49.24
5	87-06	04 Mar 87	2.06	68.75	36.36	52.56
6	80-07	28 Mar 87	2.54	99.99	26.23	63.11
7	87-07	31 Mar 87	2.21	66.67	13.21	39.94
8	87-08	21 Apr 87	2.26	42.11	11.63	26.87
9	87-12	17 Aug 87	1.83	88.89	27.27	58.08
10	87-14	22 Sep 87	3.38	92.31	27.27	59.79
11	87-14	29 Sep 87	2.25	93.75	22.22	57.99
12	88-02	13 Nov 87	1.39	17.86	30.77	24.31
13	88-05	07 Feb 88	2.75	33.33	31.82	32.58
14	88-06	29 Feb 88	2.33	66.67	42.86	54.76
15	89-01	16 Oct 88	1.64	50.00	11.11	30.56
16	89-01	19 Oct 88	1.03	36.11	35.14	35.62
17	89-02	08 Nov 88	1.20	60.00	14.29	37.14
18	89-02	14 Nov 88	1.10	53.33	15.15	34.24
19	89-03	01 Dec 88	1.11	24.44	20.00	22.22
20	89-04	11 Jan 89	0.90	23.33	0.00	11.67
21	89-10	05 Jun 89	1.89	55.56	5.88	30.72
22	89-10	10 Jun 89	1.00	52.78	13.89	33.33
23	89-11	11 Jul 89	0.88	27.12	11.54	19.33
24	89-12	06 Aug 89	0.89	13.33	2.5	7.92
25	89-12	10 Aug 89	2.42	91.67	32.76	62.21
26	89-13	30 Aug 89	0.75	31.37	2.63	17.00
27	89-13	02 Sep 89	0.76	13.33	2.94	8.14
28	89-14	23 Sep 89	1.53	67.65	11.54	39.59
29	89-14	26 Sep 89	1.13	15.09	21.67	18.38
30	90-04	16 Jan 90	1.45	22.58	24.44	23.51

F. FORCE RATIO CORRELATION

Prior to investigating the possible relationships between the three measures of effectiveness and the graphics evaluations in Chapter IV, the possible relationship between the MOEs and the starting force ratios had to be explored. Each of the MOEs were plotted against the starting force ratios in a scatter plot. The best fitted line was obtained using ordinary least squares regression as shown in Figure 3 on page 20 and Table 7 on page 20.

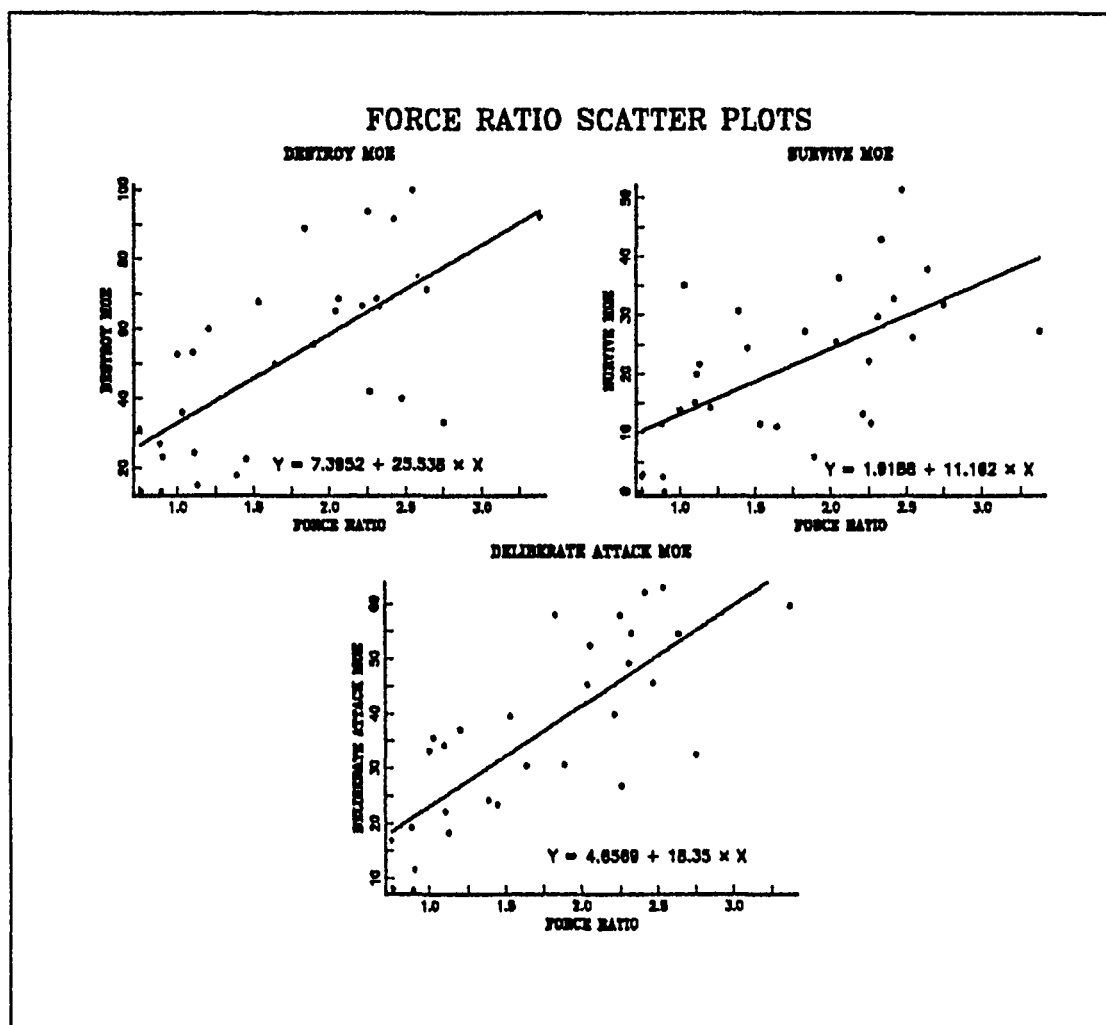


Figure 3. Force Ratio Scatter Plots

Table 7. FORCE RATIO REGRESSION ANALYSIS

MOE	NAME	R^2	Adjusted R^2	F Value	Prob > F
1	DESTROY	0.4714	0.4525	24.969	0.0001
1	SURVIVE	0.3725	0.3501	16.624	0.0003
1	DEL ATK	0.6138	0.6000	44.496	0.0001

These results show a statistical relationship between each of the measures of effectiveness and the starting force ratios. The equation for each of the fitted lines was of the form:

$$y = a + bx + e$$

The dependent variable, y , is the MOE. The x variable is the force ratio, and b is the regression coefficient which describes the magnitude of the force ratio's contribution to the MOE. The intercept term, a , has little meaning; it represents the linear extension of the curve fit for force ratio equal to zero. It matters not if it is included in the computation of the residuals. The residuals, r , represent all of the other aspects of unit performance contributing to the MOE. By rewriting the equation we can remove the force ratio effects from the MOE. This process was used on each of the measures of effectiveness prior to further analysis.

$$r = y - bx$$

There are many additional factors which impact on unit performance. As was stated at the outset of this chapter, only those areas where quantifiable subjective data was readily available were used. Measurements which would have aided in reducing the residuals of the MOEs for further analysis were the amount of planning time the units had to prepare for the mission, the number of leaders with NTC experience, and a wide range of statistics on unit training such as Skill Qualification Tests (SQT) and Army Training and Evaluation Program (ARTEP) scores from home station. Further qualifications on the research presented in this thesis will be addressed in the conclusions and recommendations chapter.

IV. OPERATIONAL GRAPHICS EVALUATION

A. GENERAL

Operational graphics are divided into three major categories: basic symbols, symbols for the ground environment, and battlefield activities. Some symbols appear in more than one category based on their usage. Basic symbols are further subdivided into units, installations, and equipment. They are used to identify friendly and enemy locations on the ground. Symbols for the ground environment are used to quickly and accurately portray battle activity with a minimum of misunderstanding [Ref. 1: p. 2-26]. The categories for these types of symbols includes present and proposed locations, points, lines, areas, obstacles, crossings, movements, indirect fire planning, and tactical deception. Battlefield activities includes offensive and defensive symbols. These symbols are used to graphically portray specific missions which may be assigned to a unit.

B. SYMBOLS USED FOR OFFENSIVE OPERATIONS

Individual symbols provide bits of information. By combining the proper symbols it is possible to convey meaning and intent for a given tactical operation. Since this research is focused on the deliberate attack, it is important to understand the scope of the symbology for offensive operations. The placement of symbols in the offense is determined by a grid reference beginning with the start of movement and ending at an objective or other control measure [Ref. 1: p. 2-63]. Under the category of battlefield activities there are 17 symbols used in offensive operations. These symbols are listed below.

- Assault position
- Assembly area
- Direction of attack
- Axis of advance
- Attack position
- Bridgehead line
- Bypass
- Follow and support
- Follow and assume main attack
- Infiltration lane

- Landing zone (LZ) / Drop zone (DZ)
- Limit of advance (LOA)
- Line of contact (LC)
- Line of departure (LD)
- Objective
- Zone of action

These symbols are not meant to be an all inclusive list, nor are they symbols which must be used. The commander must analyze his requirements using METT-T (Mission, Enemy, Terrain, Troops and Time available) in order to determine which symbology best represents what he intends to do with his subordinate elements. The impact of METT-T analysis can be seen in the following examples.

If the mission of the task force is to destroy the enemy, then the commander may not want to use the bypass symbol. This symbol defines how easy or difficult it is to avoid enemy forces in order to maintain momentum. The landing zone and drop zone are used when soldiers are moved using air assets. The commander who does not have helicopters as part of his troops would not use these symbols. Some symbols are eliminated based on the aspects of the terrain in which a unit is operating. There are no rivers in the desert at NTC. You would not expect to see the symbol for a bridgehead line, which defines the area that units occupy following a river crossing.

C. TASK FORCE DELIBERATE ATTACK EXAMPLE

In order to understand the analysis which follows, the reader must first develop a conceptual understanding of task force operational graphics for a deliberate attack. To aid in this process, a simple example is included in Figure 4 on page 24. It should be noted that this example is not intended to be a model for future operations overlays, rather it is a simple representation of some of the symbols used in offensive operations.

Referring to the figure, symbol I is a **zone of action**. The zone of action is a tactical subdivision of a larger area, the responsibility for which is assigned to a tactical unit [Ref. 1: p. 1-75]. The zone of action is made up of lateral and rear boundaries. The unit size indicator on these boundaries always reflects the largest of the two adjacent units, hence the **X** for the two boundaries with brigade units, and **II** for the boundary with the armor battalion. In the example, the zone of action is the responsibility of Task Force 3-28. From the unit designations on the rear boundary, at the left, it can be seen

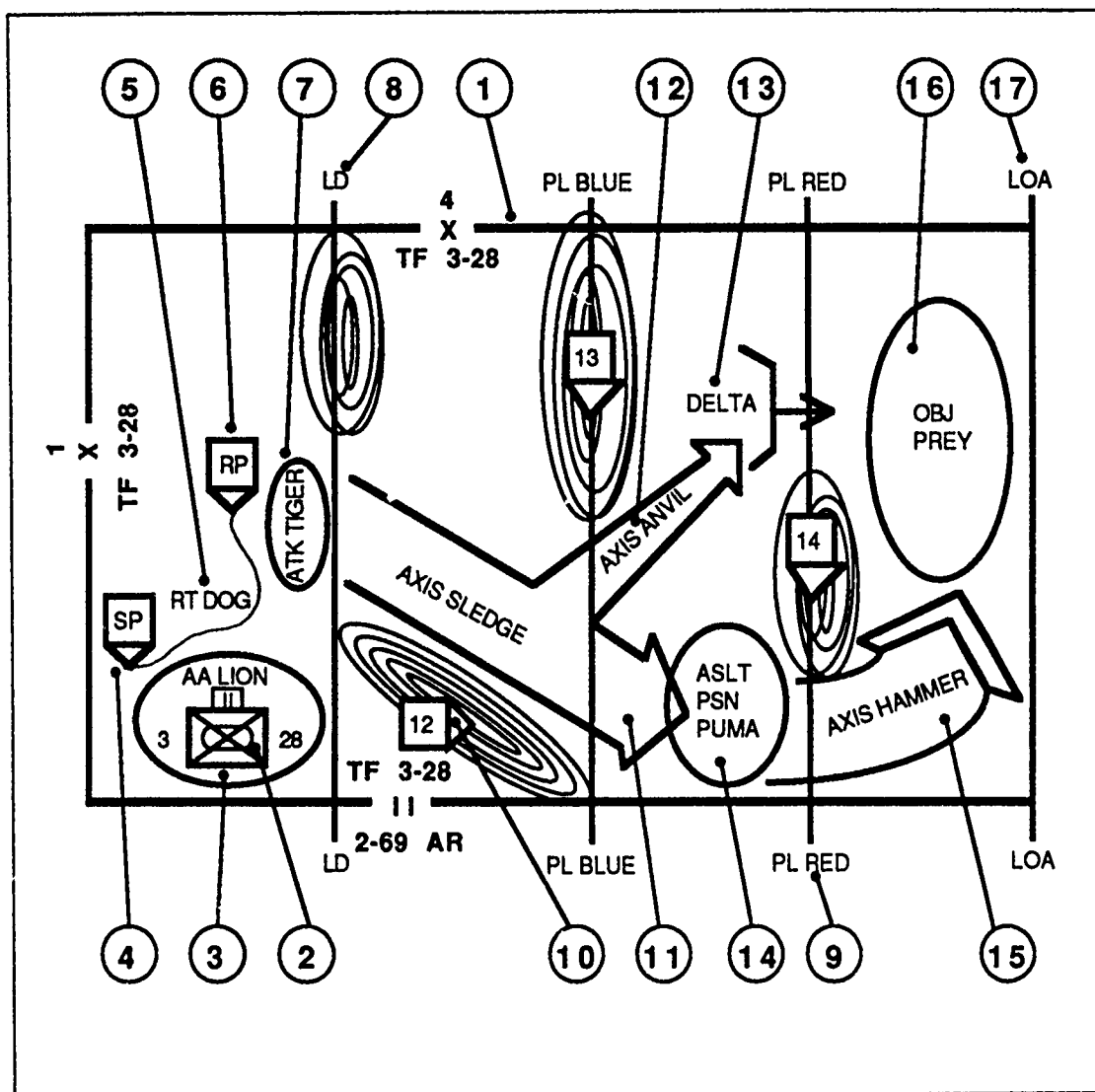


Figure 4. Example Deliberate Attack Graphics

that the element to the rear of the task force is the 1st Brigade. On the left of the task force is the 4th Brigade, and to the right is the 2nd Battalion, 69th Armor.

Symbols 2 and 3 are combined to properly represent the **task force assembly area**, AA LION. Symbol 2 is the representation of 3rd Battalion, 28th Infantry (Mechanized), and the box over the unit size designation indicates that the unit has been task organized with armor in order to form a task force. Symbol 3 defines the **assembly area** where the task force prepares for its next mission. There are many variants for representing a battalion assembly area. It would be correct to portray it in such a way as to define the

locations of all subordinate units, or to divide the area into smaller, company-sized assembly areas with their own designations.

The next three symbols are used to prescribe the route the unit will take as it moves to the attack position. These symbols are used to provide controlled, coordinated movements and to avoid disorganization as the unit moves from one point on the battlefield to another. Symbol 4 is the **start point (SP)**. This is an identifiable location on the ground where the units begin their movements. The units then travel along **route DOG**, symbol 5, until they reach symbol 6, the **release point (RP)**. Throughout the movement, the subordinate elements are under task force control. During this type of movement units generally adhere to movement tables which specify the times for crossing the SP, RP, and other points along the route.

Attack Position **TIGER**, symbol 7, is the last position occupied by the task force prior to entering enemy territory [Ref. 1: p. 1-8]. The **attack position** is used to coordinate and synchronize forces in order to prepare them for possible enemy contact. Units organize into the order of movement and designated movement formations in the attack position so that as they cross the line of departure, they are able to move rapidly and with a minimum amount of delay. The **line of departure**, symbol 8, is a line designated for the coordinated commitment of attacking units at a specified time [Ref. 1: p. 1-42]. The actual time at which units cross the LD is specified in the operation order. The crossing of the LD is the traditional initiation of the attack.

As the units move forward towards their objective, several types of symbols are used to report friendly locations and coordinate movement. Symbols 9 and 10, the **phase line** and **checkpoint** respectively, are examples of these type of symbols. The example in the figure has two phase lines, PL BLUE and PL RED. Phase lines are oriented to prominent terrain features such as hills, roads, and streams. This makes them easy to recognize during movement and helps to alleviate confusion over subordinate unit locations. Checkpoints, such as 12, 13, and 14 in the figure, are also oriented to recognizable terrain for this same reason [Ref. 1: p. 1-13].

The lateral movement boundaries for the task force are defined by the **axis of advance**, symbols 11, 12, and 15. The axis of advance not only portrays where the task force is going to go, but also what the commander's intent is during movement. The axis of advance shows how the commander intends to approach the enemy and how the task force will use the terrain to its advantage as the unit moves. The commander also designates his main effort by using a double-headed arrow to indicate the **main attack axis**.

This is shown in the figure as Axis HAMMER. By default, Axis ANVIL is the supporting attack in the example.

Some symbols are used to define actual battlefield missions as shown by symbol 13, **support-by-fire position DELTA**. This symbol has two components. The first component is the location from which the unit will fire and is defined by the bracket. The second is the arrow which provides the orientation for the occupying unit's fires. Additional coordination symbols are often used in the objective area for the shifting of these fires as the attack progresses. Such symbols have been omitted in this example for the sake of simplicity.

Symbol 14, **assault position PUMA** is the last covered and concealed position prior to the objective. The task force would organize for its final assault in this position. This organization would include grouping the subordinate units into lead and supporting units, as well as providing time to allow indirect and direct supporting fires to be brought into position. In the example, the task force would use the assault position as a holding area until units were prepared in support-by-fire position DELTA.

Gaining control of symbol 16, **objective PREY**, is the attacking force's goal. Objectives can be terrain-oriented or enemy-oriented depending on the task force mission. Often times a commander will establish intermediate objectives prior to the final objective. This is usually done when the commander has gained some sort of intelligence on possible forward enemy locations or when a particular piece of terrain dominates the maneuver area. The objective in the example is in its simplest form. As an assembly area can be subdivided, so too can the objective. This is often done by assigning company objectives within the battalion objective, or by using graphic control measures, such as phase lines or unit boundaries. One such symbol used to control forces in the objective area is symbol 17, the **limit of advance (LOA)**. This line is oriented to terrain features and marks the boundary across which the attacking force may not attack. The limits of advance can be also used to prevent friendly units from firing on one another as they converge on adjacent objectives.

This simple example contains a total of 20 symbols of 16 different types. In the evaluated deliberate attacks there were as many as 117 symbols, and as many as 27 different types. Appendices B and C contain definitions, descriptions and representations of the symbols portrayed in this example as well as those which have been omitted.

D. METHODOLOGY FOR OPERATIONAL GRAPHICS EVALUATION

The evaluation of the operational graphics used at NTC is broken down into a quantitative and a qualitative research. The questions to be addressed under quantitative research were: Which symbols were used?; How many symbols were used?; and finally, What types of symbols were used? Qualitatively, the goal was to answer the questions: Were the symbols that were used drawn correctly?; and, What is the overall score for the graphics which were used? Questions of the appropriateness of the symbols selected by the commander and subjective assessment of the commander's overall plan were not considered in this research.

In an effort to capture all of the information available from the operation overlays, a distinction was made between company and battalion symbols of the same type. A significant loss of information would occur if, for example, company objectives and battalion objectives were combined under one category. As was pointed out in the example in the previous section, company objectives are often used as partitions of battalion objectives to aid in the coordination of the fight in the objective area.

1. QUANTITATIVE OPERATIONAL GRAPHICS RESEARCH

The individual symbols used on the 30 missions were widely varied. See Table 8 on page 28 and Table 9 on page 29. A total of 1924 individual symbols and 68 different types of symbols were used. Only three types of symbols were used during every mission and they were: boundary, phase line, and zone of action. The types of symbols which were used on only one mission were: artillery battery, collecting point, communications checkpoint, forward supply point, ground surveillance radar, mortar, and retransmission point. The symbols used most frequently were checkpoints at 532 occurrences, phase lines at 187 occurrences, targets at 149 occurrences, and company objectives at 131 occurrences. A total of 20 symbols could not be defined as to purpose or type. These symbols were grouped in the "Unknown" category.

Table 8. OPERATIONAL GRAPHICS USAGE

Symbol Number	SYMBOL	Total Used	Maximum Used	Missions Using
1	Air Axis	10	3	20.0%
2	Air Control Point	23	16	6.7%
3	Air Corridor	4	2	10.0%
4	Air Defense Platoon	2	1	6.7%
5	Antiarmor Company	8	3	13.3%
6	Armor Company/Team	21	5	23.3%
7	Artillery Battery	3	3	3.3%
8	Assault Position	5	3	10.0%
9	Assembly Area (BN)	24	5	50.0%
10	Assembly Area (CO)	20	6	20.0%
11	Attack Position (BN)	8	1	26.7%
12	Attack Position (CO)	30	5	23.3%
13	Main Attack Axis	12	2	36.7%
14	Axis of Advance (BN)	54	6	76.7%
15	Axis of Advance (CO)	36	4	60.0%
16	BN Task Force (Armor)	7	5	10.0%
17	BN Task Force (Mech)	3	1	10.0%
18	Battalion Trains	7	2	16.7%
19	Battle Position (BN)	5	1	16.7%
20	Battle Position (CO)	96	11	63.3%
21	Boundary	33	3	100.0%
22	Brigade Headquarters	7	3	16.7%
23	Brigade Support Area	6	1	20.0%
24	Checkpoint	532	64	83.3%
25	Chemical Platoon	2	1	6.7%
26	Collecting Point	1	1	3.3%
27	CCP	2	2	3.3%
28	Contact Point	4	3	6.7%
29	Coordinated Fire Line	8	1	26.7%
30	Coordinating Point	26	6	23.3%
31	Decontamination Point	12	4	13.3%
32	Direction of Attack (BN)	4	2	10.0%
33	Direction of Attack (CO)	10	3	16.7%
34	Enemy Platoon	15	9	10.0%

Table 9. OPERATIONAL GRAPHICS USAGE

Symbol Number	SYMBOL	Total Used	Maximum Used	Missions Using
35	Engagement Area	20	3	43.3%
36	Engineer Platoon	4	3	6.7%
37	Forward Supply Point	1	1	3.3%
38	GSR	3	3	3.3%
39	Infiltration Lane	3	1	10.0%
40	Landing Zone	3	1	10.0%
41	Lane	18	4	23.3%
42	Limit of Advance	7	1	23.3%
43	Line of Departure	18	1	60.0%
44	LD /LC	8	1	26.7%
45	Link-Up Point	8	4	13.3%
46	Main Supply Route	4	2	10.0%
47	Mechanized Company	22	5	23.3%
48	Minefield	15	7	10.0%
49	Mortar	2	2	3.3%
50	Mortar Platoon	8	1	26.7%
51	Objective (BN)	66	5	96.7%
52	Objective (CO)	131	10	83.3%
53	Observation Post	15	5	20.0%
54	Phase Line	187	11	100.0%
55	Pick-Up Zone	2	1	6.7%
56	Reconnaissance	9	3	20.0%
57	Release Point	14	2	33.3%
58	Restrictive Fire Line	2	1	6.7%
59	Retransmission Point	1	1	3.3%
60	Route	30	5	50.0%
61	Scout Platoon	4	2	10.0%
62	Sector (CO)	4	3	6.7%
63	Smoke	2	1	6.7%
64	Start Point	16	4	36.7%
65	Support by Fire	58	13	50.0%
66	Target	149	47	43.3%
67	Unknown	20	9	13.3%
68	Zone of Action	30	1	100.0%

The wide variety of symbols which were used is not incongruent with present doctrine on deliberate attack graphics. There is no doctrinal listing of which symbols must be used. The only doctrinal reference in this area is in [Ref. 4: p. 124] which states that as a minimum, deliberate attack operational graphics include a line of departure, a time of attack, and the objective. In addition a commander may assign zones of action,

axes of advance, directions of attack, routes, phase lines, checkpoints, and fire control measures. action and a clearly defined objective.

2. QUALITATIVE ANALYSIS

a. Methodology

The standard for all military symbols is contained in FM 101-5-1, Operational Terms and Graphics. Each symbol is represented by both a written definition and an example of how the symbol is drawn. In order to qualitatively evaluate the symbols used during the deliberate attacks, a numerical evaluation methodology was created.

The first step in the development of this methodology was to break each symbol down into four major components which could then be evaluated on a Go / No Go basis. As an illustration, the definition for a phase line is, "A line used for control and coordination of military operations. It is usually a recognizable terrain feature extending across the zone of action." [Ref. 1: p. 1-55] The depiction of the symbol is as a solid line with the designation PL DELTA at each end of the line. Additional remarks with the depiction state, "Phase lines are labeled "PL" and assigned letters, numbers, or code name designations." [Ref. 1: p. 2-35] From this information the following four questions were extracted for evaluation.

1. Is the line oriented to terrain features?
2. Is PL (designation) at both ends of the line?
3. Is there no repetition of designations?
4. Does the line cross the entire sector?

Question 3 is not directly stated in the symbol definition, but is implied in other portions of [Ref. 1: p. 2-26]. Once these questions were extracted, they were written into a tabular format as shown in Table 10.

Table 10. SYMBOL EVALUATION EXAMPLE

SYMBOL	COMPONENTS	Go	No	SCR	QTY
PL ————— PL DELTA DELTA	Is the line oriented to terrain features?				
	Is PL (designation) at both ends of the line?				
	Is there no repetition of designations?				
	Does the line cross the entire sector?				
	TOTAL SCORE				

A depiction of the symbol was added to aid in the evaluation process. Tables were created for each of 85 possible symbols. While some of these symbols, such as the bridgehead line, were not used in the evaluated missions, all of the evaluation forms are included in Appendix C. These forms were created prior to the data collection process and were not influenced by the actual graphics used on the evaluated operations overlays.

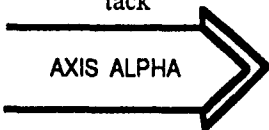


b. Evaluation Process

The evaluation of the operation overlays consisted of the following six steps being executed for each type of symbol.

1. Identify all symbols of a certain type, *i*.
2. Record the total quantity (*QUANTITY*) of that symbol.
3. Evaluate each of the individual symbols against the four questions.
4. Record the number of correct (Go) and the number of incorrect (No Go).
5. Compute the score for each question by dividing the number correct by the total quantity.
6. Total the four scores for the overall symbol score (*SCORE_i*), and record.
7. Multiply the overall symbol score (*SCORE_i*) by the the total quantity (*QUANTITY*), and record.

The result of these procedures is a table similar to Table 11 on page 32. This example has been reduced to three symbols in the interest of simplicity.

Table 11. GRAPHICS EVALUATION EXAMPLE

ROTATION: 90 - 12		TASK FORCE: Armor		DATE: 7 Dec 90	
GRAPHICS EVALUATION FORM					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
<div>axis of advance for main at- tack</div> <div></div> <div>AXIS ALPHA</div>	Does the symbol have a double arrowhead?	1	0	1.0	1
	Is the axis marked with a designation?	1	0	1.0	
	Is the axis oriented to the terrain?	1	0	1.0	
	Is there no repetition of designations?	1	0	1.0	
	TOTAL SCORE				4.0
SYMBOL	COMPONENTS	Go	No	SCR	QTY
<div>checkpoint</div> <div></div> <div>12</div>	Is the symbol oriented to a terrain feature?	20	5	0.8	25
	Is the symbol drawn as a square and triangle?	25	0	1.0	
	Is the triangle pointing to the terrain feature?	10	10	0.5	
	Is there no repetition of numbers?	21	4	0.84	
	TOTAL SCORE				3.1
SYMBOL	COMPONENTS	Go	No	SCR	QTY
<div>objective</div> <div></div> <div>OBJ PREY</div>	Is the symbol drawn as an enclosed area?	4	0	1.0	4
	Is OBJ (designation) in the symbol?	3	1	0.75	
	Is the area recognizable on the ground?	1	0	1.0	
	Is there no repetitions of designations?	2	2	0.50	
	TOTAL SCORE				3.25

Once the table has been completed it is then possible to compute an operational graphics score (OGS) for the operation overlay using the following equation.

$$OGS = 25 \times \frac{\sum_{i=1}^n (SCORE_i \times QUANTITY_i)}{\sum_{i=1}^n QUANTITY_i}, \text{ where } i = \text{symbols 1 to } n$$

The constant factor, 25, is the result of dividing through by the maximum symbol score, 4.0, and multiplying by 100 to obtain a percentage. The calculations below illustrate the use of this formula on the table example.

$$OGS = 25 \times \frac{(4.0 + 78.5 + 13.0)}{1 + 25 + 4} = 79.5$$

This methodology provides a relatively quick and efficient way to evaluate how well the symbols for a given operation overlay are drawn.

c. Evaluation Results

The results of this methodology are presented in Table 12. The high and low scores have been highlighted. The mean score across the 30 missions was 81.11%. The mean number of symbols utilized was 64 and a mean of 18 different types of symbols were used.

Table 12. OPERATIONAL GRAPHICS SCORES

NO.	ROT	DATE	TASK FORCE	TOTAL SYMBOLS	TYPES OF SYMBOLS	GRAPHICS SCORE
1	87-03	28 Nov 86	Armor	23	12	82.61%
2	87-03	02 Dec 86	Mech	43	15	86.63%
3	87-05	07 Feb 87	Armor	39	12	85.29%
4	87-06	03 Mar 87	Armor	60	19	68.77%
5	87-06	04 Mar 87	Armor	35	13	56.45%
6	87-07	28 Mar 87	Mech	31	13	75.02%
7	87-07	31 Mar 87	Armor	36	14	81.25%
8	87-08	21 Apr 87	Armor	69	16	75.06%
9	87-12	17 Aug 87	Mech	57	20	94.91%
10	87-14	22 Sep 87	Mech	66	14	72.92%
11	87-14	29 Sep 87	Armor	87	16	87.39%
12	88-02	13 Nov 87	Mech	60	16	82.92%
13	88-05	07 Feb 88	Mech	88	21	75.32%
14	88-06	29 Feb 88	Mech	76	25	83.95%
15	89-01	16 Oct 88	Armor	34	15	76.49%
16	89-01	19 Oct 88	Mech	85	14	89.16%
17	89-02	08 Nov 88	Mech	117	21	85.28%
18	89-02	14 Nov 88	Armor	40	18	76.88%
19	89-03	01 Dec 88	Armor	47	19	85.65%
20	89-04	11 Jan 89	Armor	71	23	80.64%
21	89-10	05 Jun 89	Mech	37	19	82.43%
22	89-10	10 Jun 89	Armor	89	27	83.42%
23	89-11	11 Jul 89	Armor	114	22	87.17%
24	89-12	06 Aug 89	Armor	77	21	94.53%
25	89-12	10 Aug 89	Mech	72	23	87.83%
26	89-13	30 Aug 89	Armor	76	22	64.01%
27	89-13	02 Sep 89	Mech	69	22	84.79%
28	89-14	23 Sep 89	Armor	72	21	79.51%
29	89-14	26 Sep 89	Mech	63	21	77.39%
30	90-04	16 Jan 90	Armor	91	14	89.50%

V. ANALYSIS

A. OBJECTIVE

The objective of the analysis was to evaluate the possible relationships between unit performance, as defined by the three measures of effectiveness in Chapter III, and operational graphics as defined quantitatively and qualitatively in Chapter IV. The objective was not to develop a predictive model of the form, "Using these graphics will guarantee success on deliberate attacks at NTC." It is important to distinguish between these two objectives and to recognize the scope of the analysis which follows. This will prevent the reader from inferring unsubstantiated conclusions from what is presented.

B. OPERATIONAL GRAPHICS SCORE ANALYSIS

In exploring the possible relationship between the measures of effectiveness and the operational graphics score (OGS) for each observation, nonparametric methods were first considered. Each observation was assigned a rank from 1 to 30, where 1 represented the best score, and 30 the worst, for each of the measures of effectiveness and the operational graphics score as shown in Table 13 on page 35.

Table 13. OBSERVATION RANKINGS

NO.	ROT	DATE	DESTROY MOE 1	SURVIVE MOE 2	DEL ATK MOE 3	GRAPHICS SCORE
1	87-03	28 Nov 86	20	7	14	16
2	87-03	02 Dec 86	29	1	19	8
3	87-05	07 Feb 87	10	14	12	10
4	87-06	03 Mar 87	14	12	13	28
5	87-06	04 Mar 87	9	5	8	30
6	87-07	28 Mar 87	3	19	5	26
7	87-07	31 Mar 87	12	28	20	18
8	87-08	21 Apr 87	27	29	29	25
9	87-12	17 Aug 87	1	10	1	1
10	87-14	22 Sep 87	18	27	22	27
11	87-14	29 Sep 87	2	20	4	6
12	88-02	13 Nov 87	28	4	21	15
13	88-05	07 Feb 88	30	17	30	24
14	88-06	29 Feb 88	17	3	10	13
15	89-01	16 Oct 88	15	24	18	23
16	89-01	19 Oct 88	13	2	3	4
17	89-02	08 Nov 88	5	18	6	11
18	89-02	14 Nov 88	8	13	9	22
19	89-03	01 Dec 88	22	9	17	9
20	89-04	11 Jan 89	21	26	26	19
21	89-10	05 Jun 89	16	30	25	17
22	89-10	10 Jun 89	7	15	7	14
23	89-11	11 Jul 89	19	16	16	7
24	89-12	06 Aug 89	24	25	28	2
25	89-12	10 Aug 89	4	11	2	5
26	89-13	30 Aug 89	11	23	15	29
27	89-13	02 Sep 89	23	22	27	12
28	89-14	23 Sep 89	6	21	11	20
29	89-14	26 Sep 89	25	6	23	21
30	90-04	16 Jan 90	26	8	24	3

Hypothesis testing was then done using both the Kendall Tau statistic and the Spearman coefficient of rank correlation. The null hypothesis tested under the Kendall Tau statistic was: There is no association between the MOE and the OGS. The alternative hypothesis was: An association exists. In order to test this hypothesis the methodology described in [Ref. 5: pp. 284-287] was utilized. Each of the matched pairs (X, Y) , where X was the MOE rank and Y the OGS rank, were listed in increasing order from 1 to 30 by the MOE rank. The number of pairs of Y ranks that appeared in natural order were then totalled to obtain a value for U .

The Tau coefficient was then calculated and used to compute the test statistic, Z , using the following formulae:

$$T = \frac{4U}{n(n-1)} - 1$$

$$Z = \frac{3T\sqrt{n(n-1)}}{\sqrt{2(2n+5)}}$$

The Spearman coefficient was computed to support the Kendall Tau results. This procedure was also taken from [Ref. 5: pp. 275-281]. The null hypothesis for this test was: No association exists between the ranks of the MOE and the OGS. The alternative hypothesis was: An association exists. The first step was to compute the difference, D_i , of each of the paired observations (X, Y). Each of the D_i values were then squared and totalled. The coefficient of rank correlation, R was then calculated along with the test statistic Z , using the following formulae.

$$R = \frac{6 \sum_{i=1}^{30} D_i^2}{n(n^2 + 1)}$$

$$Z = R\sqrt{n-1}$$

The range of values for both the Kendall Tau and the Spearman coefficient are from -1 to 1. A value of -1 indicates a perfect inverse association, a value of 1 means perfect association, and if X and Y are independent both R and T should be close to zero. The results of these tests are shown in Table 14 on page 37.

Table 14. NONPARAMETRIC STATISTICS

KENDALL TAU			
Statistic	MOE 1	MOE 2	MOE 3
T	0.0023	0.2000	0.1494
Z	0.0178	1.5522	1.1596
p value	0.4920	0.0606	0.1230
SPEARMAN'S COEFFICIENT			
Statistic	MOE 1	MOE 2	MOE 3
R	0.0220	0.3046	0.2062
Z	0.1186	1.6401	1.1106
p value	0.4522	0.0505	0.1335

From the values of the test statistic, z , the p values were estimated from a standard normal table. Each p value is the smallest value of α for which the calculated test statistic would lead to a rejection of the null hypothesis.

The results of the Spearman's coefficient and Kendall Tau statistics indicated that some level of positive association existed between the ranks of MOE 2 and MOE 3 and the ranks of the OGSs. In order to further explore this relationship, the MOE scores, adjusted for force ratio, were plotted against the operational graphics scores in a scatter plot. The best fitted line was obtained using linear least squares regression as shown in Table 15 and Figure 5 on page 38. Large values of R^2 here would indicate a linear relationship between the MOE's and the OGS's.

Table 15. SYMBOL QUALITY REGRESSION ANALYSIS

MOE	NAME	R^2	Adjusted R^2	F Value	Prob > F
1	DESTROY	0.0008	-0.0349	0.021	0.8858
2	SURVIVE	0.0247	-0.0114	0.684	0.4154
3	DEL ATK	0.0116	-0.0237	0.329	0.5711

No statistically significant conclusions could be drawn from this methodology. Because unit operational graphics are only one component of many concomitant

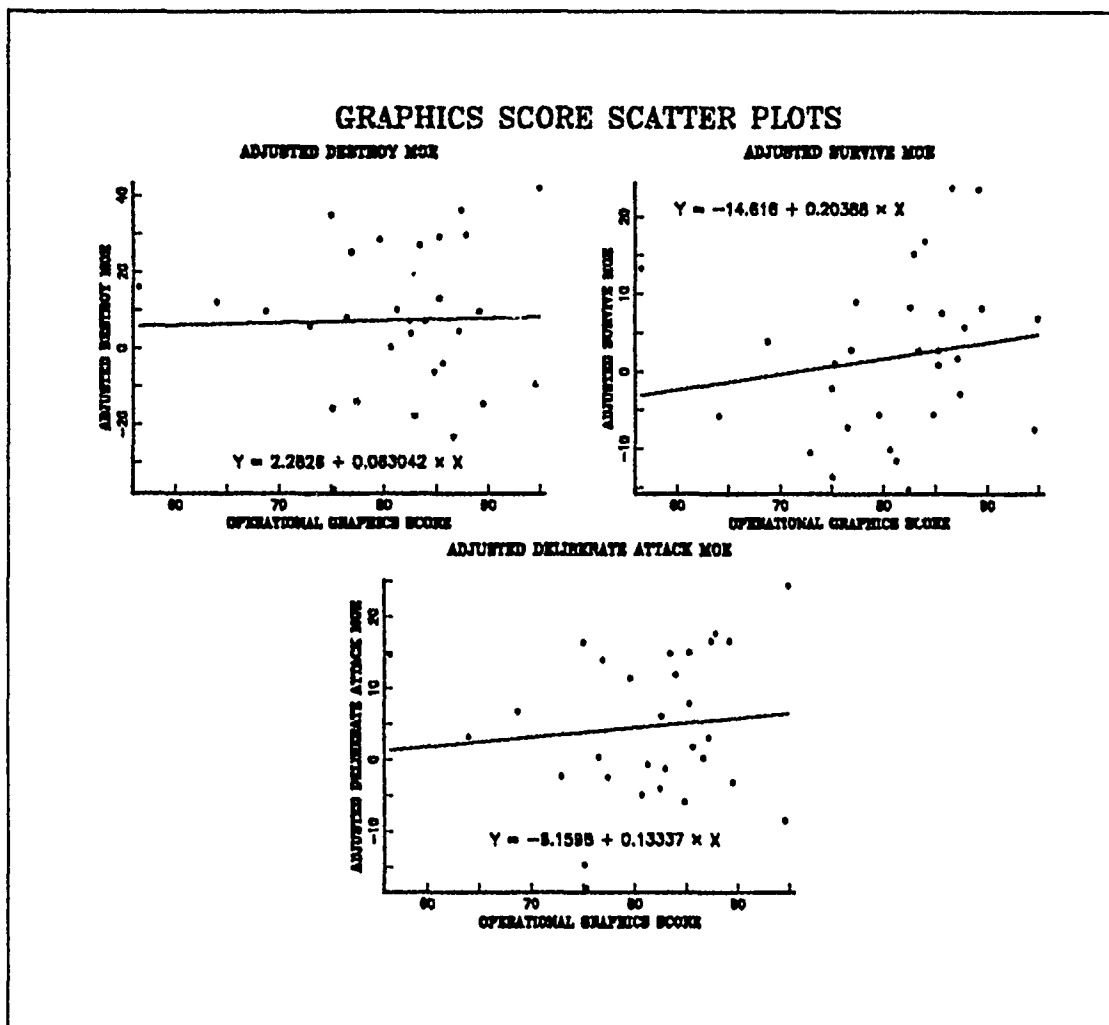


Figure 5. Graphics Score Scatter Plots

components in unit performance, and because the relationships are not necessarily linear, the lack of statistically significant results was not surprising.

C. SYMBOL ANALYSIS

The previous analysis indicates that there is some relationship between unit performance and operational graphics performance, the next area for analysis was that of symbol usage. Was there a relationship between the use of a particular symbol and the unit performance defined by the MOEs? In order to answer this question, the quantities of each symbol for each of the 30 observations was regressed against each of the three measures of effectiveness. Only two symbols whose use appeared to help unit performance were found. These symbols were the company objective and the company axis of

advance. The results of the regression are displayed in Table 16 on page 39 and Figure 6 on page 40.

Use of multiple company attack axis appeared to positively influence unit performance for the survival MOE and the deliberate attack MOE, while the use of multiple company objectives was similarly related to success for the destruction MOE and the deliberate attack MOE. These were the only results of any significance found in the individual symbol analysis.

Table 16. INDIVIDUAL SYMBOL REGRESSION ANALYSIS

COMPANY AXIS OF ADVANCE					
MOE	NAME	R^2	<i>Adjusted R²</i>	F Value	Prob > F
1	DESTROY	0.0476	0.0136	1.399	0.2469
2	SURVIVE	0.1092	0.0773	3.431	0.0746
3	DEL ATK	0.1369	0.1061	4.441	0.0442
COMPANY OBJECTIVE					
MOE	NAME	R^2	<i>Adjusted R²</i>	F Value	Prob > F
1	DESTROY	0.1137	0.0821	3.592	0.0684
2	SURVIVE	0.0084	-0.0270	0.236	0.6306
3	DEL ATK	0.1456	0.1151	4.773	0.0374

D. USE OF SYMBOL COMBINATIONS

As was stated in Chapter IV, individual symbols only portray pieces of information. They must be put together in a logical form in order to convey a message. Multiple stepwise regression was done in an attempt to answer the question, "Was there a small subset of symbols which could be used to describe the unit performance on each of the measures of effectiveness?"

The first problem with this methodology dealt with degrees of freedom for the multiple regression. There were 30 observations to be described and 68 symbols with which to do the describing. The largest number of symbols which could be used, and still allow for the necessary degrees of freedom, was 26. In an effort to reduce the number of symbols, all unit symbols were consolidated into one category and the unknown symbols were omitted. This reduced the total number of symbols to 53. Alternative methods of

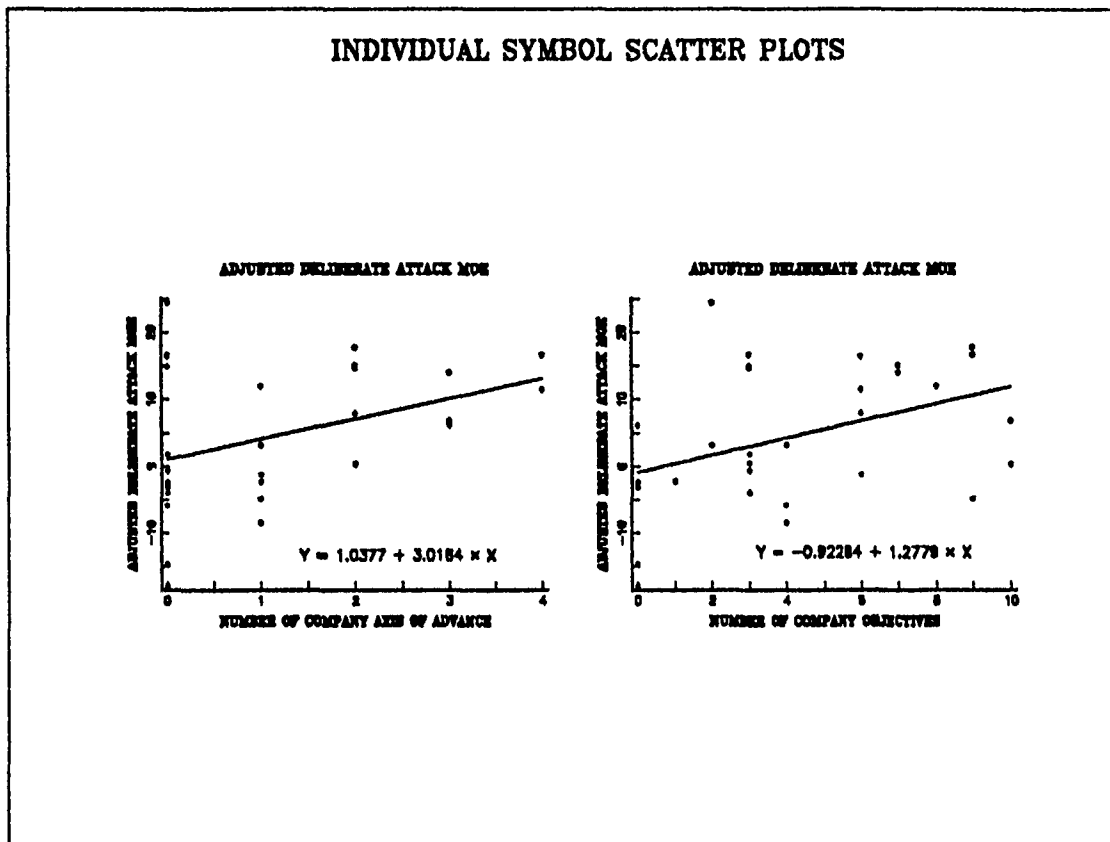


Figure 6. Individual Symbol Scatter Plots

grouping the symbols were examined, but rejected on the basis of a lack of transparency of results.

Multiple regression, utilizing forward selection, backward elimination, and maximum R^2 was used to analyze the statistical relationship between the symbols and the MOEs. This was done using the the software described in [Ref. 6: pp. 763-774]. Both the forward selection and backward elimination process picked the same symbols to describe the unit performance for each MOE. The maximum R^2 procedure was then applied to find the "best" model using from 1 to 30 symbols to describe the model. Because the model was over-parameterized, models beyond 26 variables were discarded.

Only one method was available for the selection of the "best" overall model, and this consisted of examining the cumulative R^2 plots of the models selected by the maximum R^2 methodology. These plots are shown in Figure 7 on page 42. Computation of additional statistics such as Mallows' C_p , was not possible due to the over-parameterization of the model. This limitation can be demonstrated by considering the equation for Mallows' C_p

$$C_p = \frac{SSE_p}{MSE} - (N - 2p)$$

SSE_p is the sum-of-squares error for a model with p variables plus the intercept, and it is divided by the mean square error for the full model. If the model is over-parameterized, the MSE approaches zero, making it impossible to accurately calculate the C_p value.

Because of the problems with degrees of freedom, the symbols which were selected for each of the models were omitted from further analysis. What can be used from this procedure is the fact that for each of the three MOEs, a five variable model was found with an R^2 value above 0.50.

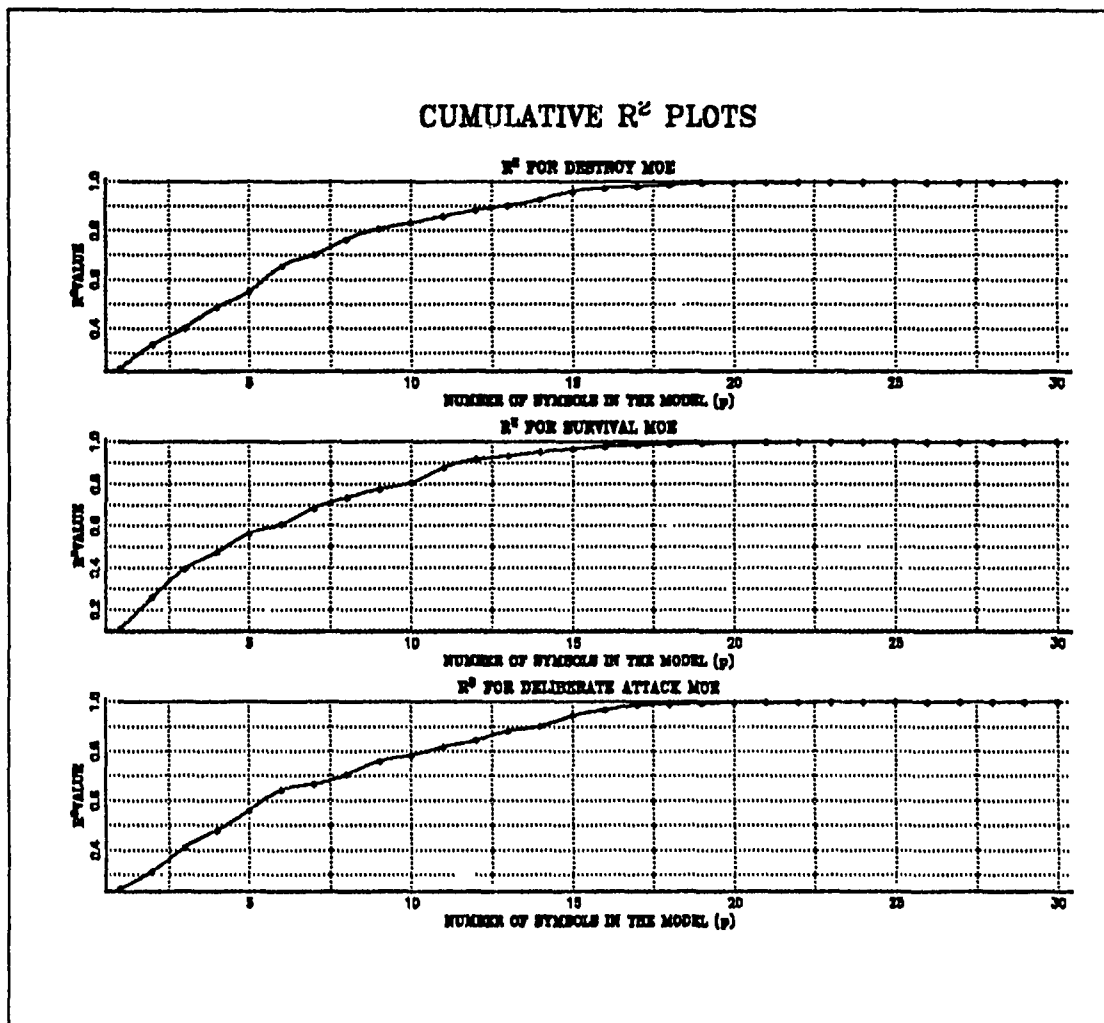


Figure 7. Cumulative R^2 Plots

E. QUANTITY OF SYMBOLS

The total quantity of symbols utilized was analyzed to determine if it had any statistical relationship to the measures of effectiveness. The premise behind this investigation was that a plan with few symbols might be easier to execute; or, on the other hand, too few symbols may fail to convey the commander's intent sufficiently for battlefield success. The total number of symbols used during each battle were plotted against each MOE in a scatter plot. Figure 8 on page 44 shows the results of this procedure. The best fit was found using ordinary least squares regression. Table 17 shows that there was no statistically significant relationship between the number of symbols used and the measures of effectiveness.

One possible explanation for this is the terrain on which each battle took place. While the battles used in the analysis were restricted to the Southern Corridor, there was a great deal of variation in the size and location of the assigned zones of action. As an illustration, two zones of action of equal size could have radically different terrain, and thus different requirements for operational graphics. Similarly, zones of unequal size might require more or fewer symbols to depict the commander's intent.

Table 17. SYMBOL QUANTITY REGRESSION ANALYSIS

MOE	NAME	R^2	Adjusted R^2	F Value	Prob > F
1	DESTROY	0.0012	-0.0345	0.033	0.8572
2	SURVIVE	0.0000	-0.0370	0.000	0.9840
3	DEL ATK	0.0006	-0.0351	0.016	0.8989

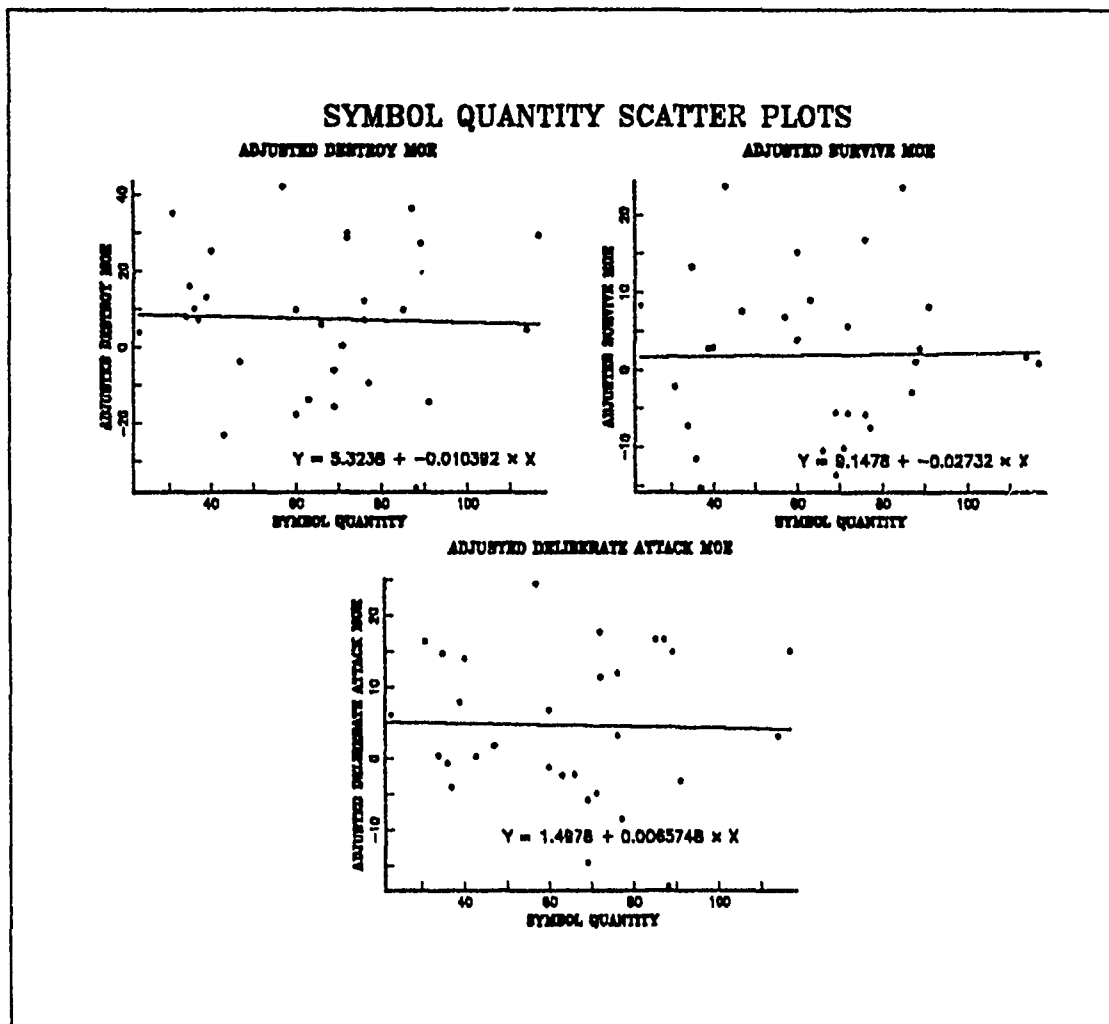


Figure 8. Symbol Quantity Scatter Plots

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The following hypothesis was presented for evaluation: Given a task force deliberate attack conducted under NTC conditions, there exists a relationship between the operational graphics used and how a unit performed during that mission. Based on the analysis presented in Chapter V, there is evidence to support this hypothesis.

The most important relationship demonstrated was the association between unit performance and operational graphics quality. Both the Kendall Tau and Spearman's coefficient hypothesis tests showed that a positive association existed between unit performance, as defined by the three MOE's, and the OGS, or how well the operational graphics were drawn. Although only the p values for MOE 2 was conclusive, when combined with the fact that there are many concomitant factors impacting on unit performance, this was considered sufficient evidence that there probably is a relationship between the three MOE's and the OGS's.

Another relationship which has been demonstrated concerns the importance of the company axis of advance and company objective symbols in describing the unit performance across the thirty battles. It has been shown that the quantity of these symbols had a statistical relationship with higher MOE scores. Both the company axis of advance and company objective are symbols which are used to provide detail to subordinate commanders in a tactical plan. It makes sense that the units which provided greater detail in their plans would perform better than the units which did not. The relationship which was demonstrated was descriptive and not necessarily causal in nature.

The final relationship between operational graphics and unit performance was incomplete, however; the methodology showed promise for further research. Multiple stepwise regression demonstrated that the unit performance could be successfully modelled using a subset of five symbols. With more observations, this procedure could be utilized to identify the most important symbols in defining unit performance over a series of deliberate attack missions.

While not directly related to the hypothesis, the identification and removal of the concomitant effect of the force ratio on unit performance was also demonstrated. The statistical significance of this effect also points toward a possible area for further research. Other possible concomitant variables are mentioned on pages 12, 13.

B. RECOMMENDATIONS

The operational graphics evaluation methodology defined and applied in this thesis can be used to evaluate unit performance in the preparation of operational overlays. This process could assist deploying units in improving their ability to effectively communicate mission requirements and commander's intent. This would result in the creation of training standards for operational overlays and fill a void in the existing performance feedback network at NTC. By maintaining the results of these evaluations at the CTC archive, further research could be done in this area with a focus on possible revisions in operational graphics doctrine.

In order to exploit the research methodology of this thesis two key things must be accomplished. Sufficient observations must be collected in order to fully exploit statistical methods such as multiple stepwise regression and Mallow's C_p , categorical data analysis, and factor analysis. These techniques, combined with identification and elimination of concomitant factors influencing unit performance (as discussed in Chapter III), would provide clearer and more useful results for application to training and doctrine.

APPENDIX A. OPERATIONAL TERMS DEFINITIONS

- advance guard** The security element operating to the front of a moving force [Ref. 1: p. 1-1].
- air assault** Operations in which air assault forces (combat, combat support (CS), and combat service support (CSS), using the firepower, mobility, and total integration of helicopter assets in their ground or air roles, maneuver on the battlefield under the control of the ground or air maneuver commander to engage and destroy enemy forces. [Ref. 1: p. 1-1]
- airborne** A force composed of ground and air units organized, equipped, and trained for primary delivery by airdrop into an area [Ref. 1: p. 1-2].
- breakout from encirclement** An offensive operation conducted by an encircled force. A breakout normally consists of an attack by a penetration force to open a gap through the enemy for the remainder of the force to pass. [Ref. 1: p. 1-12]
- combat service support (CSS)** The assistance provided to sustain combat forces, primarily in the fields of administration and logistics. It includes administrative services, chaplain services, civil affairs, food services, finance, legal services, maintenance, medical services, supply, transportation, and other logistical services. [Ref. 1: p. 1-16]
- combat support (CS)** Fire support and operational assistance provided to combat elements. Includes artillery, air defense artillery, engineer, military police, signal, military intelligence, and chemical. [Ref. 1: p. 1-16]
- commander's intent** Commander's vision of the battle - how he expects to fight and what he expects to accomplish [Ref. 1: p. 1-17].
- concept of operations** A graphic, verbal, or written statement in broad outline that gives an overall picture of a commander's assumptions or intent in regard to an operation or series of operations; includes as a minimum the scheme of maneuver and fire support plan. The concept of operations is embodied in campaign plans and operations plans particularly when the plans cover a series of connected operations to be carried out simultaneously or in succession. It is described in sufficient detail for the staff and subordinate commanders to understand what they are to do and how to fight the battle without further instructions. [Ref. 1: p. 1-18]
- covering force** A combined arms force with a mission to cover [Ref. 1: p. 1-21].
- decisive terrain** Key terrain is decisive terrain if it has an extraordinary impact on the mission. Decisive terrain is rare and will not be present in every situation. To designate terrain as decisive is to recognize that the successful accomplishment of the mission, whether offensive or defensive, depends on seizing or retaining it. The commander designates decisive terrain to communicate its importance in his concept of operations, first to his staff and, later, to his subordinate commanders. [Ref. 1: p. 1-22]

defense of a battle position A mission which places a unit in a battle position (BP) to concentrate its fires, to limit its maneuver, or to place it in an advantageous position to counterattack. The BP is a general location on the ground. The commander positions his forces on the best terrain within and in the vicinity of the BP. The commander may position security forces forward of and about the BP. He can also locate combat support (CS) and combat service support (CSS) elements outside the BP. The commander can maneuver his forces freely within the BP and seize the initiative to maneuver outside the BP to attack enemy forces. [Ref. 1: p. 1-23]

defense of a sector A mission which requires a defending unit to prevent enemy forces from passing beyond the rear boundary of the sector, while retaining flank security, and ensuring integrity of effort within the parent unit's scheme of maneuver. Initial positions generally are established as far forward as possible, but the commander may use any technique to accomplish the mission. [Ref. 1: p. 1-23]

defense of a strongpoint A mission which implies retention of the position at all costs. Repeated assaults must be expected and repelled. CS and CSS assets may be employed outside the strongpoint. [Ref. 1: p. 1-23]

defensive operations A defense is a coordinated effort by a force to defeat an attacker and prevent him from achieving his objectives. [Ref. 1: p. 1-23]

delaying operations An operation usually conducted when the commander needs time to concentrate or withdraw forces, to establish defenses in greater depth, to economize in an area, or to complete offensive actions elsewhere. In the delay, the destruction of the enemy force is secondary to slowing his advance to gain time. [Ref. 1: p. 1-24]

deliberate attack An attack planned and carefully coordinated with all concerned elements based on thorough reconnaissance, evaluation of all available intelligence and relative combat strength, analysis of various courses of action, and other factors affecting the situation. It generally is conducted against a well-organized defense when a hasty attack is not possible or has been conducted and failed. [Ref. 1: p. 1-8]

exploitation An offensive operation that usually follows a successful attack to take advantage of weakened or collapsed enemy defenses. Its purpose is to prevent reconstitution of enemy defenses, to prevent enemy withdrawal, and to secure deep objectives. [Ref. 1: p. 1-31]

flank guard A security element operating to the flank of a moving or stationary force [Ref. 1: p. 1-33].

forward edge of the battle area (FEBA) The forward limit of the main battle area (MBA) [Ref. 1: p. 1-34].

guard operations A guard force accomplishes all the tasks of a screening force. Additionally, a guard force prevents enemy ground observation of and direct fire against the main body. A guard force reconnoiters, attacks, defends, and delays as necessary to accomplish its mission. A guard force normally operates within the range of the main body indirect fire weapons. [Ref. 1: p. 1-64]

- hasty attack** An offensive operation for which a unit has not made extensive preparations. It is conducted with the resources immediately available in order to maintain momentum or to take advantage of the enemy situation. [Ref. 1: p. 1-8]
- hasty water crossings** The crossing of a water obstacle using crossing means at hand or readily available without pausing to make elaborate preparations [Ref. 1: p. 1-36].
- key terrain** Any locality or area the seizure, retention, or control of which affords a marked advantage to either combatant [Ref. 1: p. 1-40].
- linkup** A meeting of friendly ground forces (such as when an advancing force reaches an objective area previously seized by an airborne or air assault force, when an encircled element breaks out to rejoin friendly forces, or when converging maneuver forces meet.) [Ref. 1: p. 1-42].
- main battle area (MBA)** That portion of the battlefield extending rearward from the forward edge of the battle area (FEBA) and in which the decisive battle is fought to defeat the enemy attack. Designation of the MBA includes the use of lateral and rear boundaries. For any particular command, this area extends from the FEBA to the rear boundaries of those units comprising its main defensive forces. [Ref. 1: p. 1-43]
- main body** The principle part of a tactical command or formation. It does not include detached elements of the command such as advance guards, flank guards, covering forces, etc. [Ref. 1: p. 1-43]
- maneuver** The movement of forces supported by fire to achieve a position of advantage from which to destroy or threaten destruction of the enemy [Ref. 1: p. 1-44].
- movement to contact** An offensive operation designed to gain initial ground contact with the enemy or to regain lost contact [Ref. 1: p. 1-49].
- obstacle reduction** The reduction or elimination of any natural or man-made obstruction that canalizes, delays, restricts, or diverts movement of a force [Ref. 1: p. 1-51].
- offensive operations** The offense is a combat operation designed primarily to destroy the enemy. Offensive operations may be undertaken to secure key or decisive terrain. To deprive the enemy of resources or decisive terrain, to deceive and/or divert the enemy, to develop intelligence, and to hold the enemy in position. The offense is undertaken to seize, retain, and exploit the initiative, and as such, is a principle of war. [Ref. 1: p. 1-52]
- passage of lines** Passing one unit through the positions of another, as when elements of a covering force withdraw through the forward edge of the main battle area, or when an exploiting force moves through the elements of the force that conducted the initial attack. A passage may be designated as a forward or rearward passage of lines. [Ref. 1: p. 1-54]
- pursuit** An offensive operation against a retreating enemy force. It follows a successful attack or exploitation and is ordered when an enemy cannot conduct an organized defense and attempts to disengage. Its objective is to maintain

relentless pressure on the enemy and completely destroy him. [Ref. 1: p. 1-57]

reconnaissance A mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of a potential enemy, or about meteorologic, hydrographic, or geographic characteristics of a particular area [Ref. 1: p. 1-60].

relief operations A relief in place is an operation in which a unit is replaced in combat by another unit. Responsibilities for the combat mission and the assigned sector or zone of action of the replaced unit are assumed by the incoming unit. [Ref. 1: p. 1-61]

retirement A retrograde operation in which a force out of contact moves away from an enemy [Ref. 1: p. 1-62].

retrograde operations An organized movement to the rear away from the enemy. It may be forced by the enemy or may be made voluntarily. Such movements may be classified as withdrawal, retirement, or delaying operations. [Ref. 1: p. 1-62]

screening force A screening force maintains surveillance, provides early warning to the main body, impedes and harasses the enemy with supporting indirect fires, and destroys enemy reconnaissance elements within its capability [Ref. 1: p. 1-64].

sector An area designated by boundaries within which a unit operates and for which it is responsible. Normally, sectors are used in defensive operations. [Ref. 1: p. 1-64]

secure To gain possession of a position or terrain feature, with or without force, and to deploy in a manner which prevents its destruction or loss to enemy action [Ref. 1: p. 1-64].

seize To clear a designated area and to obtain control of it [Ref. 1: p. 1-65].

strongpoint A key point in a defensive position, usually strongly fortified and heavily armed with automatic weapons, around which other positions are grouped for its protection [Ref. 1: p. 1-67].

withdrawal A retrograde operation in which a force in contact with the enemy frees itself for a new mission [Ref. 1: p. 1-75].

zone of action A tactical subdivision of a larger area, the responsibility for which is assigned to a tactical unit; generally applied to offensive action [Ref. 1: p. 1-75].

APPENDIX B. OPERATIONAL GRAPHICS DEFINITIONS

- abatis** A vehicular obstacle constructed by felling trees 1-2 meters above the ground on both sides of a road so that they fall, interlocked, toward the expected direction of enemy approach. The trees should remain attached to the stumps, be at a 45-degree angle to the roadway, and the obstacle should be at least 75 meters in depth to be most effective. [Ref. 1: p. 1-1]
- air assault** Operations in which air assault forces (combat, combat support (CS), and combat service support (CSS), using the firepower, mobility, and total integration of helicopter assets in their ground or air roles, maneuver on the battlefield under the control of the ground or air maneuver commander to engage and destroy enemy forces. [Ref. 1: p. 1-1]
- airborne force** A force composed of ground and air units organized, equipped, and trained for primary delivery by airdrop into an area [Ref. 1: p. 1-2].
- air control point (ACP)** An easily identifiable point on the terrain or an electronic navigational aid used to provide necessary control during air movement. ACPs are generally designated at each point where the flight route makes a definite change in direction and any other point deemed necessary for timing or control of the operation. [Ref. 1: p. 1-2]
- air corridor** A restricted air route of travel specified for use by friendly aircraft and established to prevent friendly aircraft from being fired on by friendly forces [Ref. 1: p. 1-2].
- airhead line** A line described or portrayed in an operation order (OPORD) which marks the outside limit of that part of the airhead to be denied to the enemy [Ref. 1: p. 1-3].
- airspace coordination area (ACA)** A block of airspace in the target area in which friendly aircraft are reasonably safe from friendly surface fires. It may occasionally be a formal measure (a three-dimensional box in the sky). More often, it is informal. The purpose of the ACA is to allow the simultaneous attack of targets near each other by multiple fire support means, one of which normally is air. Formal ACAs are established by a separate brigade or higher level command. Informal ACAs may be established as low as task force (TF) level. [Ref. 1: p. 1-4]
- ambush** A surprise attack by fire from concealed positions on a moving or temporarily halted enemy [Ref. 1: p. 1-5].
- ammunition transfer point (ATP)** A point established in the brigade support area (BSA) to reduce the travel distances of resupply vehicles. Initial stockage for each brigade ATP is positioned on corps support command (COSCOM) stake and platform (S&P) semitrailers, and consists of high volume/high tonnage items as determined by the division ammunition officer (DAO) and the division commander. [Ref. 1: p. 1-5]
- assault objectives** Key terrain features or installations whose seizure facilitates the overall accomplishment of an airborne or air assault operation [Ref. 1: p. 1-7].

- assault position** That position between the line of departure (LD) and the objective in an attack from which forces assault the objective. Ideally, it is the last covered and concealed position before reaching the objective (primarily used for dismounted infantry). [Ref. 1: p. 1-7]
- assembly area** An area in which a force prepares or regroups for further action [Ref. 1: p. 1-7].
- attack position** The last position occupied or passed through by the assault echelon before crossing the line of departure (LD) [Ref. 1: p. 1-8].
- axis of advance** A general route of advance, assigned for purposes of control, which extends toward the enemy. An axis of advance symbol graphically portrays a commander's intention, such as avoidance of built-up areas or envelopment of an enemy force. It follows terrain suitable for the size of the force assigned the axis and is often a road, a group of roads, or a designated series of locations. A commander may maneuver his forces and supporting fires to either side of an axis of advance provided the unit remains oriented on the axis and the objective. Deviations from an assigned axis of advance must not interfere with the maneuver of adjacent units without prior approval of the higher commander. Enemy forces that do not threaten security or jeopardize mission accomplishment may be bypassed. An axis of advance is not used to direct the control of terrain or the clearance of enemy forces from specific locations. Intermediate objectives normally are assigned for these purposes. [Ref. 1: p. 1-8]
- battalion task force** A force generally organized by combining tank and mechanized infantry elements under a single single battalion commander to conduct specific operations. A battalion task force may be tank-heavy, mechanized infantry-heavy, or balanced, depending on the concept and plan of operation. [Ref. 1: p. 1-9]
- battle position (BP)** A defensive location oriented on the most likely enemy avenue of approach from which a unit may defend or attack. Such units can be as large as battalion task forces and as small as platoons. A unit assigned a BP is located within the general outline of the BP. Security, combat support (CS), and combat service support (CSS) forces may operate outside a BP to provide early enemy detection and all around security. [Ref. 1: p. 1-10]
- booby trap** A device designed to kill or maim an unsuspecting person who disturbs an apparently harmless object or performs a normally safe act [Ref. 1: p. 1-11].
- boundary** A control measure normally drawn along identifiable terrain features and used to delineate areas of tactical responsibility for subordinate units. Within their boundaries, units may maneuver within the overall plan without close coordination with neighboring units unless otherwise restricted. Direct fire may be placed across boundaries on clearly identified enemy targets without prior coordination, provided friendly forces are not endangered. Indirect fire may also be used after prior coordination. Lateral boundaries are used to control combat operations of adjacent units. Rear boundaries are established to facilitate command and control. [Ref. 1: p. 1-11]

- bridgehead line** In offensive river crossing operations, the limit of the objective area when developing the bridgehead [Ref. 1: p. 1-12].
- brigade support area (BSA)** A designated area in which combat service support (CSS) elements from division support command (DISCOM) and corps support command (COSCOM) provide logistic support to a brigade. The BSA is normally located 20 to 25 kilometer behind the forward edge of the battle area (FEBA). [Ref. 1: p. 1-12]
- bypass** Maneuvering around an obstacle, position, or enemy force to maintain the momentum of advance. Previously unreported obstacles are reported to higher HQ. Bypassed enemy forces are reported to higher HQ. [Ref. 1: p. 1-12]
- checkpoint** A predetermined point on the ground used as a means of coordinating friendly movement. Checkpoints are not used as reference points in reporting enemy locations. [Ref. 1: p. 1-13]
- classes of supply** The grouping of supplies, by type, into ten categories to facilitate supply management and planning [Ref. 1: p. 1-14].
- collecting point** A facility established within the corps or division. A general collecting point is a facility established for the control of civilians, prisoners, or stragglers. A maintenance collection point is established to collect equipment awaiting repair, controlled exchange, cannibalization, or evacuation. May be operated by the user or by intermediate maintenance units. [Ref. 1: p. 1-15]
- communications checkpoint (CCP)** An air control point that requires serial leaders to report either to the aviation mission commander or the terminal control facility [Ref. 1: p. 1-17].
- company team** A team formed by attachment of one or more nonorganic tank, mechanized infantry, or light infantry platoons to a tank, mechanized infantry or light infantry company either in exchange for or in addition to organic platoons [Ref. 1: p. 1-18].
- contact point** A designated easily identifiable point on the terrain where two or more units are required to physically meet [Ref. 1: p. 1-18].
- convoy** A group of 10 or more vehicles organized for the purpose of control and orderly movement with or without escort protection [Ref. 1: p. 1-19].
- coordinated fire line (CFL)** A line beyond which conventional surface fire support means (mortars, field artillery, naval gunfire ships) may fire at any time within the zone of the establishing HQ without additional coordination. It is usually established by brigade or division, but may be established by a maneuver battalion. [Ref. 1: p. 1-19]
- coordinating point** A control measure that indicates a specific location for the coordination of fires and maneuver between adjacent units. They usually are indicated whenever a boundary crosses the forward edge of the battle area (FEBA), and may be indicated when a boundary crosses report lines or phase lines (PLs) used to control security forces. [Ref. 1: p. 1-20]

- crossing site** The location along a water obstacle where the crossing can be made using amphibious vehicles, assault boats, rafts, bridges, or fording vehicles [Ref. 1: p. 1-21].
- desired ground zero (DGZ)** The point on the ground on, above, or below which it is desired that a nuclear weapon be detonated. The aiming point for the weapon. [Ref. 1: p. 1-25].
- direction of attack** A specific direction or route that the main attack or main body of the force will follow. If used, it is normally at battalion and lower levels. Direction of attack is a more restrictive control measure than axis of advance, and units are not free to maneuver off the assigned route. It is usually associated with infantry units conducting night attacks, or units involved in limited visibility operations, and in counterattacks. [Ref. 1: p. 1-25]
- division support area (DSA)** An area normally located in the division rear positioned near airlanding facilities and along the main supply route (MSR). The DSA contains the division support command post (DISCOM CP), the HQ elements of the DISCOM battalions, and those DISCOM elements charged with providing backup support to the combat service support (CSS) elements in the brigade support area (BSA) and direct support (DS) to units located in the division rear. Selected corps support command (COSCOM) elements may be located in the division support area (DSA) to provide DS backup and general support (GS) as required. [Ref. 1: p. 1-26].
- drop zone (DZ)** A specified area upon which airborne troops, equipment, or supplies are airdropped by parachute, or on which supplies and equipment may be delivered by free fall [Ref. 1: p. 1-27].
- encirclement** The loss of freedom of maneuver resulting from enemy control of all ground routes of evacuation and reinforcement [Ref. 1: p. 1-29].
- engagement area** An area in which the commander intends to trap and destroy an enemy force with massed fires of all available weapons. Engagement areas are routinely identified by a target reference point in the center of the trap area or by prominent terrain features around the area. Although engagement areas may also be divided into sectors of fire, it is important to understand that defensive systems are not designed around engagement areas, but rather around avenues of approach. Engagement areas and sectors of fire are not intended to restrict fires or cause operations to become static or fixed; they are only used as a tool to concentrate fires and to optimize their effects. [Ref. 1: p. 1-30]
- fallout** Radioactive particles produced by a nuclear detonation which fall from the nuclear cloud in a pattern determined primarily by wind factors [Ref. 1: p. 1-31].
- feint** An offensive operation intended to draw the enemy's attention away from the area of the main attack, which induces the enemy to move his reserves or to shift his fire support in reaction to the feint. Feints must appear real; therefore, some contact with the enemy is required. Usually limited-objective attack ranging in size from a raid to a supporting attack is conducted. [Ref. 1: p. 1-31]

final coordination line A line close to the enemy position used to coordinate the lifting and shifting of supporting fires with the final deployment of maneuver elements. It should be recognizable on the ground. It is not a fire support coordination measure. [Ref. 1: p. 1-31]

fire support coordination line (FSCL) A line established by the appropriate ground commander to ensure coordination of fire not under his control but which may effect current tactical operations. The FSCL is used to coordinate fires of air, ground, or sea weapons systems using any type of ammunition against surface targets. The FSCL should follow well-defined terrain features. The establishment of the FSCL must be coordinated with the appropriate tactical air commander and other supporting elements. Supporting elements may attack targets forward of the FSCL, without prior coordination with the ground force commander, provided the attack will not produce adverse surface effects on, or in the rear of, the line. Attacks against surface targets behind this line must be coordinated with the appropriate ground forces commander. [Ref. 1: p. 1-32]

follow and support force A committed force which follows a force conducting an offensive operation, normally an exploitation or pursuit. Such a force is not a reserve but is committed to accomplish any or all of these tasks: destroy bypassed units; relieve in place any direct pressure or encircling force which has halted to contain the enemy; block movement of reinforcements; secure lines of communication (LOC); guard prisoners, key areas, and installations; secure key terrain; and control refugees. [Ref. 1: p. 1-33]

ford A shallow part of a body of water that can be crossed without bridging, boats, or rafts. A location in a water barrier where the physical characteristics of current, bottom, and approaches permit the passage of personnel and/or vehicles and other equipment that remain in contact with the bottom. [Ref. 1: p. 1-33]

forward arming and refueling point (FARP) A temporary facility that is organized, equipped, and deployed by an aviation unit commander, and located closer to the area of operation than the aviation unit's combat service support (CSS) area. It provides fuel and ammunition necessary for the employment of helicopter units in combat. [Ref. 1: p. 1-33]

forward edge of the battle area (FEBA) The forward limit of the main battle area (MBA) [Ref. 1: p. 1-34].

forward line of own troops (FLOT) A line that indicates the most forward positions of friendly forces in any kind of military operation at a specific time. The FLOT may be at, beyond, and short of the FEBA, depicting the nonlinear battlefield. [Ref. 1: p. 1-34]

free fire area (FFA) A specific designated area into which any weapon system may fire without additional coordination with the establishing headquarters [Ref. 1: p. 1-34].

gap Any break or breach in the continuity of tactical dispositions or formations beyond effective small arms coverage. A portion of a minefield of specified width, in which no mines have been laid, to enable a friendly force to pass through the minefield in tactical formation. [Ref. 1: p. 1-35]

- group of targets** Two or more targets on which fire is desired simultaneously. A group of targets is designated by a letter-number combination or a nickname. [Ref. 1: p. 1-35]
- height of burst** The vertical distance from the earth's surface or target to the point of burst [Ref. 1: p. 1-36].
- holding line** In retrograde river crossing operations, the outer limit of the area established between the enemy and the water obstacle to preclude direct and observed indirect fires into crossing areas [Ref. 1: p. 1-37].
- infiltration** The movement through or into an area or territory occupied by either friendly troops or organizations. The movement is made, either by small groups or by individuals, at extended or irregular intervals. When used in connection with the enemy, it implies contact is avoided. When used in conjunction with a tactical vehicular march, vehicles are dispatched individually or in small groups at irregular intervals to reduce density and prevent undue massing of vehicles. [Ref. 1: p. 1-38]
- landing zone (LZ)** A specified zone within an objective area used for landing aircraft [Ref. 1: p. 1-41].
- lane** A clear route through an obstacle. A lane for foot troops is a minimum of 1 meter in width and may be further expanded. A foot lane is marked with tracing tape along its center line. A single lane for vehicles is a minimum of 8 meters in width; a double lane is at least 15 meters in width. Vehicle lanes are marked by any means available. [Ref. 1: p. 1-41]
- light line (LL)** A designated line forward of which vehicles are required to use black-out lights at night [Ref. 1: p. 1-42].
- limit of advance (LOA)** An easily recognized terrain feature beyond which attacking elements will not advance [Ref. 1: p. 1-42].
- line of contact (LC)** A general trace delineating the location where two opposing forces are engaged [Ref. 1: p. 1-42].
- line of departure (LD)** A line designated to coordinate commitment of attacking units or scouting elements at a specified time. A start line. [Ref. 1: p. 1-42]
- line of departure is line of contact (LD/LC)** The designation of forward friendly positions as the LD when opposing forces are in contact [Ref. 1: p. 1-42].
- lines of communication (LOC)** All the routes (land, water, and air) that connect an operating military force with one or more bases of operations and along which supplies and military forces move [Ref. 1: p. 1-42].
- linkup point** An easily identifiable point on the ground where two forces conduct a linkup meet. When one force is stationary, linkup points normally are established where the moving force's routes of advance intersect the stationary force's security elements. Linkup points for two moving forces are established on boundaries where the two forces are expected to converge. [Ref. 1: p. 1-42]
- main supply route** The route or routes designated within an area of operations on which the bulk of traffic flows in support of military operations [Ref. 1: p. 1-34].

- minefield** An area of ground containing mines laid with or without pattern [Ref. 1: p. 1-46].
- minimum safe distance (MSD)** The minimum distance in meters from desired ground zero (DGZ) at which a specific degree of risk and vulnerability will not be exceeded with a 99 percent assurance [Ref. 1: p. 1-47].
- no-fire area (NFA)** An area in which no fires or effects of fires are allowed. Two exceptions are (1) when establishing headquarters approves fires temporarily within the NFA on a mission basis, and (2) when the enemy force within the NFA engages a friendly force, the commander may engage the enemy to defend his force. [Ref. 1: p. 1-50]
- objective** The physical object of the action taken (for example, a definite terrain feature, the seizure and/or holding of which is essential to the commander's plan, or, the destruction of an enemy force without regard to terrain features) [Ref. 1: p. 1-50].
- observation post (OP)** A position from which military observations (visual, audible, or other means) are made, or fire is directed and adjusted, and that possesses appropriate communications; it may also be airborne [Ref. 1: p. 1-51].
- obstacle** Any natural or man-made obstruction that canalizes, delays, restricts, or diverts movement of a force. The effectiveness of an obstacle is enhanced considerably when covered by fire. Obstacles can include abatis, antitank ditches, blown bridges, built-up areas, minefields, rivers, road craters, terrain, and wire. [Ref. 1: p. 1-51]
- passage lanes** Areas along which a passing unit moves to avoid stationary units and obstacles [Ref. 1: p. 1-54].
- passage point** A place where units will pass through one another either in an advance or withdrawal. It is located where the commander desires subordinate units to physically execute a passage of lines. [Ref. 1: p. 1-54]
- phase line (PL)** A line used for control and coordination of military operations. It is usually a recognizable terrain feature extending across the zone of action. Units normally report crossing PLs, but do not halt unless specifically directed. PLs are often used to prescribe the timing of delay operations. [Ref. 1: p. 1-55]
- pickup zone (PZ)** A geographical area used to pick up troops and/or equipment by helicopter [Ref. 1: p. 1-55].
- point of departure** In night attacks, a specific place on the line of departure (LD) where a unit will cross [Ref. 1: p. 1-55].
- pop-up point (PUP)** The location at which aircraft quickly gain altitude for target acquisition and engagement [Ref. 1: p. 1-55].
- probable line of deployment (PLD)** A line previously selected on the ground where attacking units deploy prior to beginning an assault; it is generally used under conditions of limited visibility [Ref. 1: p. 1-57].
- radiation dose rate** The radiation dose (dosage) absorbed per unit of time. A radiation dose rate can be set at some particular unit of time (that is, H + 1 hour would be called H + 1 radiation dose rate). [Ref. 1: p. 1-58]

- rally point** An easily identifiable point on the ground at which units can reassemble/reorganize if they become disbursed [Ref. 1: p. 1-59].
- release point** A clearly-defined control point on a route at which specific elements of a column of ground vehicles or flight of aircraft revert to their respective commanders, each one of these elements continuing its movement toward its own appropriate destination. In dismounted attacks, especially at night, that point at which a commander releases control of subordinate units to their commanders/leaders. [Ref. 1: p. 1-61]
- remotely employed sensors (REMS)** Remotely monitored devices implanted in an area to monitor personnel and/or vehicle activity. A sensor system consists of REMs, sensor relays, and sensor monitoring equipment. [Ref. 1: p. 1-61]
- remotely piloted vehicle (RPV)** A remotely piloted airborne reconnaissance, surveillance, and target-aquisition and designation device. RPVs provide timely and accurate intelligence and locate targets behind enemy lines. [Ref. 1: p. 1-61]
- restrictive fire area (RFA)** An area in which specific restrictions are imposed and into which fires that exceed those restrictions may not be delivered without prior coordination with the establishing headquarters [Ref. 1: p. 1-62].
- restrictive fire line (RFL)** A line established between converging friendly forces (one or both moving) that prohibits fires or effects from fires across the line without coordination with the affected force. It is established by the commander of the converging forces. [Ref. 1: p. 1-62]
- route** The prescribed course to be traveled from a specific point of origin to a specific destination [Ref. 1: p. 1-62].
- scatterable mine** A mine laid without regard to classical pattern that is designed to be delivered by aircraft, artillery, missile, ground dispenser, or hand thrown [Ref. 1: p. 1-63].
- sector** An area designated by boundaries within which a unit operates and for which it is responsible. Normally sectors are used in defensive operations. [Ref. 1: p. 1-64]
- sensor** Equipment that detects and indicates terrain configuration, the presence of military targets, and other natural and manmade objects and activities, by means of energy reflected or emitted by such targets or objects. The energy may be nuclear, electromagnetic (including the visible and invisible portions of the spectrum), chemical, biological, thermal, or mechanical (including sound, blast, and earth vibration). [Ref. 1: p. 1-65]
- series of targets** In fire support, a number of targets and or group(s) of targets planned in a predetermined time sequence to support the maneuver phase. A series of targets is indicated by a code name or nickname. [Ref. 1: p. 1-65]
- smoke** An artificially produced aerosol of solid, liquid, or vapor in the atmosphere which weakens the the passage of visible light or other forms of electromagnetic radiation. Smoke is classified in three general categories: identification smoke, obscuration smoke, and screening smoke. [Ref. 1: p. 1-66]

- start point (SP)** A clearly defined initial control point on a route at which specified elements of a column of ground vehicles or flight of aircraft come under the control of the commander having responsibility for the movement [Ref. 1: p. 1-67].
- strongpoint (SP)** A key point in a defensive position, usually strongly fortified and heavily armed with automatic weapons, around which other positions are grouped for its protection [Ref. 1: p. 1-67].
- target** A geographical area, complex, or installation planned for capture or destruction by military forces. In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed. An area designated and numbered for future firing. [Ref. 1: p. 1-70]
- target reference point (TRP)** An easily recognizable point on the ground (either natural or manmade) used for identifying enemy targets or controlling fires. TRPs are usually designated by company commanders or platoon leaders for company teams, platoons, sections, or individual weapons. They can also designate the center of an area where the commander plans to distribute or converge fires of all his weapons rapidly. TRPs are designated by using the standard target symbol and target numbers issued by the fire support team (FIST) or fire support officer (FSO). Once designated, TRPs also constitute indirect fire targets. [Ref. 1: p. 1-71]
- traffic control point (TCP)** A place at which traffic is controlled either by military police or by mechanical means [Ref. 1: p. 1-73].
- turning movement** A variation of an envelopment in which the attacking force passes around or over the enemy's principal defensive positions to secure objectives that are deep in the enemy's rear. In doing so, it forces the enemy to abandon his positions, divert major forces to meet the threat, and to fight in two directions simultaneously. [Ref. 1: p. 1-73]
- withdrawal** A retrograde operation in which a force in contact with the enemy frees itself for a new mission [Ref. 1: p. 1-75].
- zone of action** A tactical subdivision of a larger area, the responsibility for which is assigned to a tactical unit; generally applied to offensive action [Ref. 1: p. 1-75].

APPENDIX C. SYMBOL USAGE

SYMBOL	DELIBERATE ATTACK NUMBER																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOT			
AIR AXIS	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	1	2	0	1	10		
AIR CONTROL POINT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	7	0	1	23		
AIR CORRIDOR	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	4		
AIR DEFENSE PLT	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2		
ANTIARMOR COMPANY	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	3	0	1	8		
ARMOR COMPANY/TEAM	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	2	0	5	2	0	0	6	1	0	1	21			
ARTILLERY BATTERY	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	3		
ASSAULT POSITION	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5		
ASSEMBLY AREA (BN)	1	0	0	1	2	0	0	0	1	0	0	1	0	2	1	0	0	5	1	0	1	1	0	1	1	4	0	0	0	0	1	24		
ASSEMBLY AREA (CO)	1	0	0	0	6	0	0	0	0	5	0	0	4	0	0	1	0	0	0	2	0	0	0	0	2	0	0	0	0	0	1	20		
ATK POSITION (BN)	1	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	1	8		
ATK POSITION (CO)	1	0	0	0	5	0	4	0	0	0	0	0	0	0	5	0	0	3	0	0	0	0	0	4	0	0	4	5	0	0	1	30		
MAIN ATTACK AXIS	1	0	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	1	1	1	0	0	2	0	0	0	1	1	0	1	12		
AXIS OF ADVANCE (BN)	1	0	0	6	1	2	1	1	1	1	1	0	1	2	0	1	1	6	3	2	6	0	2	4	1	1	1	0	2	5	2	1	54	
AXIS OF ADVANCE (CO)	1	3	2	2	3	2	0	0	0	0	1	0	1	0	1	2	4	2	3	0	1	0	0	1	1	2	1	0	4	0	0	1	36	
BN TASK FORCE (ARMOR)	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	1	7	
BN TASK FORCE (MECH)	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	
BATTALION TRAINS	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	7	
BATTLE POSITION (BN)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	1	5	
BATTLE POSITION (CO)	1	5	0	1	0	0	5	0	4	1	1	0	0	0	0	4	0	11	4	5	11	0	3	7	1	6	6	6	0	6	9	1	96	
BOUNDARY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	1	1	1	1	1	1	1	1	1	1	1	1	33		
BRIGADE HQ (ARMOR)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	1	1	0	0	1	0	0	0	0	0	0	0	1	7	
BRIGADE SUPPORT AREA	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	6
CHECKPOINT	1	0	3	8	13	0	6	5	37	14	37	5	30	42	26	0	55	47	0	7	0	3	8	64	37	22	12	3	15	10	23	1	532	
CHEM PLATOON/SECTION	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	2		
COLLECTING POINT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	
CCP	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	
CONTACT POINT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	4	
COORDINATED FIRE LINE	1	0	0	1	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	8	
COORDINATING POINT	1	0	3	0	0	0	0	6	0	4	4	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	26
DECONTAMINATION POINT	1	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4	1	12	
DIR OF ATTACK (BN)	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4	
DIR OF ATTACK (CO)	1	2	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	1	10	
ENEMY PLATOON	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	3	0	0	0	1	15	

SYMBOL	DELIBERATE ATTACK NUMBER																														TOT		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
ENGAGEMENT AREA	1	2	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	2	0	1	2	2	3	0	1	1	0	1	0	2	0	20	
ENGINEER PLATOON	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	4	
FORWARD SUPPLY POINT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
GSR	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	
INFILTRATION LANE	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	
LANDING ZONE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	3	
LANE	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	4	0	0	3	2	2	0	0	0	3	0	0	0	18	
LIMIT OF ADVANCE	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	7	
LINE OF DEPARTURE	1	0	1	0	0	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0	1	18	
LD /LC	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	1	0	0	1	1	0	1	8	
LINKUP POINT	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	0	0	0	8	
MAIN SUPPLY ROUTE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	4	
MECH COMPANY/TEAM	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	2	0	4	2	0	0	5	3	0	0	22	
MINEFIELD	1	0	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	15	
MORTAR	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
MORTAR PLATOON	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	8	
OBJECTIVE (BATTALION)	1	1	1	4	1	1	3	1	2	1	1	1	2	4	3	3	5	2	3	4	0	1	4	3	1	1	0	3	4	5	1	66	
OBJECTIVE (COMPANY)	1	0	10	6	10	3	6	3	0	2	1	9	6	0	8	3	3	7	7	3	9	3	3	2	4	9	4	4	6	0	0	131	
OBSERVATION POST	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	5	0	0	0	2	1	0	0	0	0	15	
PHASE LINE	1	4	4	7	4	7	2	8	8	8	4	6	4	7	9	6	11	4	5	8	6	5	9	6	3	5	8	11	5	7	6	187	
PICK-UP ZONE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	
RECONNAISSANCE	1	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	2	0	1	9	
RELEASE POINT	1	0	0	0	1	0	0	0	0	0	0	0	1	2	0	0	1	1	0	0	2	1	2	0	0	2	0	1	0	0	0	14	
RESTRICTIVE FIRE LINE	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	
RETRANSMISSION POINT	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	
ROUTE	1	0	0	0	1	0	0	0	1	0	3	0	0	5	0	0	1	1	3	3	0	2	1	3	1	0	1	2	2	0	0	0	30
SCOUT PLATOON	1	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	
SECTOR (COMPANY)	1	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
SMOKE	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	
START POINT	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	1	1	0	0	2	1	4	0	0	2	0	1	0	0	1	58
SUPPORT BY FIRE	1	0	3	0	0	0	2	0	0	4	0	0	0	2	3	0	0	13	1	1	0	0	1	0	0	6	6	7	5	3	1	1	16
TARGET	1	1	10	0	4	0	0	3	0	0	0	47	3	3	0	0	0	0	0	4	5	25	4	0	0	0	9	0	0	31	1	149	
UNKNOWN	1	0	0	0	7	9	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	
ZONE OF ACTION	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	30	
TOTAL PER ROTATION	123	43	39	60	35	31	36	69	57	66	87	60	88	76	34	85	117	40	47	71	37	89	114	77	72	76	69	72	63	91	11924		

APPENDIX D. SYMBOL USAGE

SYMBOL	DELIBERATE ATTACK NUMBER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AIR AXIS	1	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00
AIR CONTROL POINT	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIR CORRIDOR	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIR DEFENSE PLT	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
ANTIARMOR COMPANY	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
ARMOR COMPANY/TEAM	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
ARTILLERY BATTERY	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASSAULT POSITION	1	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
ASSEMBLY AREA (BN)	1	0.00	0.00	3.00	3.50	0.00	0.00	0.00	3.00	0.00	0.00	3.00	0.00	3.00	0.00
ASSEMBLY AREA (CO)	1	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	2.00	0.00	0.00
ATK POSITION (BN)	1	0.00	0.00	0.00	2.00	3.00	0.00	2.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
ATK POSITION (CO)	1	0.00	0.00	0.00	0.00	3.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
MAIN ATTACK AXIS	1	0.00	4.00	0.00	0.00	0.00	4.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	4.00
AXIS OF ADVANCE (BN)	1	0.00	0.00	3.00	4.00	4.00	4.00	3.00	4.00	4.00	0.00	4.00	3.50	0.00	4.00
AXIS OF ADVANCE (CO)	1	4.00	4.00	4.00	3.33	2.00	0.00	0.00	0.00	0.00	3.00	0.00	4.00	0.00	4.00
BN TASK FORCE (ARMOR)	1	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BN TASK FORCE (MECH)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	4.00	0.00	0.00
BATTALION TRAINS	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
BATTLE POSITION (BN)	1	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BATTLE POSITION (CO)	1	3.00	0.00	3.00	0.00	0.00	3.00	0.00	2.75	4.00	3.00	0.00	0.00	0.00	3.00
BOUNDARY	1	3.00	2.00	3.00	3.00	4.00	2.00	4.00	4.00	3.00	3.00	4.00	3.00	4.00	2.00
BRIGADE HEADQUARTERS	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
BRIGADE SUPPORT AREA	1	0.00	0.00	3.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00
CHECKPOINT	1	0.00	4.00	3.38	3.85	0.00	2.67	3.60	2.95	3.86	2.73	3.40	3.80	2.74	3.84
CHEM PLATOON/SECTION	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COLLECTING POINT	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCP	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
CONTACT POINT	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
COORDINATED FIRE LINE	1	0.00	0.00	4.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	2.00	0.00	3.00	4.00
COORDINATING POINT	1	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.67	0.00	3.50	3.00	4.00	3.00	3.00
DECONTAMINATION POINT	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	3.00
DIR OF ATTACK (BN)	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	3.00	0.00
DIR OF ATTACK (CO)	1	4.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00
ENEMY PLATOON	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00







SYMBOL	DELIBERATE ATTACK NUMBER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ENGAGEMENT AREA	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	3.00	0.00	0.00	4.00
ENGINEER PLATOON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORWARD SUPPLY POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
GSR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INFILTRATION LANE	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LANDING ZONE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
LANE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	3.00	0.00
LIMIT OF ADVANCE	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
LINE OF DEPARTURE	0.00	4.00	0.00	0.00	0.00	3.00	3.00	3.00	4.00	0.00	0.00	4.00	4.00	2.00	0.00
LD /LC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LINKUP POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
MAIN SUPPLY ROUTE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
MECH COMPANY/TEAM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
MINEFIELD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00	0.00	0.00	0.00	0.00	0.00
MORTAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
MORTAR PLATOON	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	3.00	0.00	0.00	0.00	0.00
OBJECTIVE (BATTALION)	4.00	4.00	3.50	3.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	3.00	4.00	3.33	4.00
OBJECTIVE (COMPANY)	0.00	3.00	3.17	2.60	3.00	3.00	3.00	0.00	4.00	3.00	3.00	3.00	0.00	2.25	3.00
OBSERVATION POST	0.00	4.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PHASE LINE	3.75	4.00	4.00	3.50	3.29	3.00	3.00	2.75	3.67	3.00	3.67	3.75	3.29	3.56	2.67
PICK-UP ZONE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
RECONNAISSANCE	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	2.67	0.00	0.00	0.00	0.00
RELEASE POINT	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	3.50	0.00
RESTRICTIVE FIRE LINE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
RETRANSMISSION POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROUTE	0.00	0.00	0.00	4.00	0.00	3.00	0.00	3.00	0.00	1.50	0.00	0.00	2.00	0.00	0.00
SCOUT PLATOON	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
SECTOR (COMPANY)	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
SMOKE	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
START POINT	0.00	0.00	0.00	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
SUPPORT BY FIRE	0.00	4.00	0.00	0.00	0.00	2.50	0.00	0.00	4.00	0.00	0.00	0.00	4.00	2.67	0.00
TARGET	2.00	3.70	0.00	3.75	0.00	0.00	4.00	0.00	0.00	0.00	3.81	3.67	3.67	0.00	0.00
UNKNOWN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZONE OF ACTION	4.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	4.00	3.00	3.00	2.00







SYMBOL	DELIBERATE ATTACK NUMBER																													
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30															
AIR DEFENSE PLT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00															
AIR AXIS	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	3.00	1.00	0.00															
AIR CONTROL POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88	0.00	0.00	1.71	0.00															
AIR CORRIDOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00															
ANTIARMOR COMPANY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	2.00	0.00	1.66	0.00															
ARMOR COMPANY/TEAM	0.00	0.00	0.00	0.00	0.00	4.00	4.00	0.00	4.00	4.00	0.00	0.00	3.83	3.00	0.00															
ARTILLERY BATTERY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
ASSAULT POSITION	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
ASSEMBLY AREA (BN)	0.00	2.00	3.00	0.00	2.00	2.00	3.00	0.00	3.00	3.00	3.00	0.00	0.00	0.00	3.00															
ASSEMBLY AREA (CO)	4.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00															
ATK POSITION (BN)	0.00	0.00	3.00	0.00	4.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	4.00	0.00															
ATK POSITION (CO)	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	3.00	4.00	0.00	0.00															
MAIN ATTACK AXIS	0.00	0.00	0.00	4.00	4.00	4.00	0.00	0.00	4.00	0.00	0.00	0.00	4.00	4.00	0.00															
AXIS OF ADVANCE (BN)	4.00	4.00	4.00	4.00	4.00	0.00	4.00	3.73	4.00	4.00	4.00	0.00	4.00	4.00	4.00															
AXIS OF ADVANCE (CO)	4.00	4.00	2.00	0.00	4.00	0.00	0.00	0.00	3.00	4.00	3.00	4.00	0.00	3.75	0.00															
BN TASK FORCE (ARMOR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	2.80															
BN TASK FORCE (MECH)	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
BATTALION TRAINS	0.00	3.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00															
BATTLE POSITION (BN)	0.00	0.00	0.00	4.00	2.00	0.00	0.00	4.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00															
BATTLE POSITION (CO)	0.00	2.09	3.00	3.00	3.00	0.00	3.00	2.71	4.00	3.33	2.50	3.00	0.00	3.67	3.33															
BOUNDARY	3.00	3.00	4.00	3.00	4.00	3.00	3.00	4.00	3.00	3.00	4.00	4.00	3.00	4.00	3.00															
BRIGADE HQ (ARMOR)	0.00	4.00	0.00	4.00	4.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
BRIGADE SUPPORT AREA	0.00	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
CHECKPOINT	3.62	3.62	0.00	4.00	0.00	4.00	4.00	3.59	3.95	3.77	3.57	4.00	3.00	3.80	3.34															
CHEM PLATOON/SECTION	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00															
COLLECTING POINT	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
CCP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
CONTACT POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00															
COORDINATED FIRE LINE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	4.00	0.00	0.00	0.00	0.00	3.00															
COORDINATING POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
DECONTAMINATION POINT	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00															
DIR OF ATTACK (BN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00															
DIR OF ATTACK (CO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00															
ENEMY PLATOON	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															





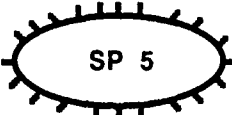

SYMBOL	DELIBERATE ATTACK NUMBER														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ENGAGEMENT AREA	0.00	4.00	0.00	4.00	4.00	4.00	4.00	0.00	4.00	4.00	0.00	4.00	0.00	4.00	0.00
ENGINEER PLATOON	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
FORWARD SUPPLY POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GSR	0.00	0.00	0.00	0.00	0.00	0.00	3.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INFILTRATION LANE	2.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LANDING ZONE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	4.00	0.00	0.00
LANE	0.00	0.00	0.00	3.50	0.00	0.00	3.00	4.00	4.00	0.00	0.00	0.00	3.00	0.00	0.00
LIMIT OF ADVANCE	4.00	4.00	0.00	0.00	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
LINE OF DEPARTURE	3.00	4.00	3.00	3.00	0.00	0.00	0.00	4.00	2.00	3.00	4.00	4.00	0.00	0.00	3.00
LD /LC	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	1.00	0.00
LINKUP POINT	0.00	0.00	0.00	4.00	0.00	0.00	0.00	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
MAIN SUPPLY ROUTE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00	0.00	0.00	0.00	0.00
MECH COMPANY/TEAM	0.00	0.00	0.00	0.00	0.00	4.00	0.00	4.00	4.00	4.00	0.00	0.00	4.00	3.00	0.00
MINEFIELD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00
MORTAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MORTAR PLATOON	0.00	1.00	3.00	0.00	0.00	1.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
OBJECTIVE (BATTALION)	3.00	4.00	4.00	4.00	3.75	0.00	4.00	4.00	4.00	4.00	3.00	0.00	3.67	4.00	3.80
OBJECTIVE (COMPANY)	3.00	3.14	2.43	4.00	2.78	4.00	3.00	3.00	4.00	4.00	3.00	4.00	3.00	0.00	0.00
OBSERVATION POST	0.00	0.00	0.00	0.00	3.00	0.00	3.80	0.00	0.00	0.00	4.00	3.00	0.00	0.00	0.00
PHASE LINE	5.64	3.75	3.60	3.13	4.00	3.00	2.33	5.14	2.33	3.60	3.75	3.73	3.00	3.86	3.83
PICK-UP ZONE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00
RECONNAISSANCE	0.00	0.00	0.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	2.50	0.00
RETRANSMISSION POINT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RELEASE POINT	0.00	3.00	4.00	0.00	0.00	4.00	4.00	4.00	0.00	0.00	3.50	0.00	2.00	0.00	0.00
RESTRICTIVE FIRE LINE	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROUTE	3.00	4.00	3.00	1.33	0.00	4.00	4.00	4.00	3.00	0.00	4.00	2.00	2.50	0.00	0.00
SCOUT PLATOON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00
SECTOR (COMPANY)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SMOKE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
START POINT	4.00	3.00	4.00	0.00	0.00	4.00	4.00	3.75	0.00	0.00	2.50	0.00	2.00	0.00	0.00
SUPPORT BY FIRE	0.00	4.00	4.00	3.00	0.00	0.00	4.00	0.00	0.00	3.67	3.83	3.71	1.80	3.67	4.00
TARGET	0.00	0.00	0.00	0.00	4.00	4.00	3.76	3.50	0.00	0.00	0.00	3.89	0.00	0.00	4.00
UNKNOWN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZONE OF ACTION	3.00	3.00	3.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	3.00	3.00	4.00	4.00	3.00

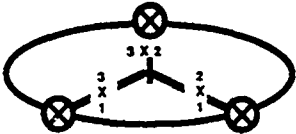
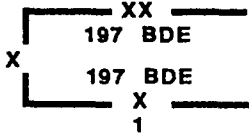



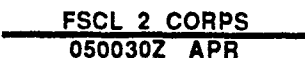
APPENDIX E. GRAPHICS EVALUATION FORM



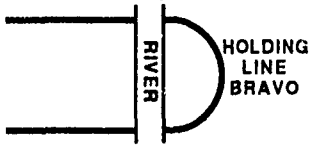



This appendix contains the graphics evaluation forms which were used in the data reduction process. The evaluation sheets are broken down by Points, Lines, Areas, Routes, Unit Symbols, Crossings, and Battlefield Missions. Some of the symbols represented in this appendix were not utilized by any of the evaluated deliberate attacks. The evaluation forms are presented, nevertheless, as an insight to the graphics evaluation methodology, and as a guide for future research and application.


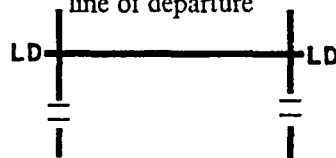



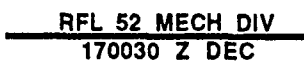
ROTATION:		TASK FORCE:		DATE:			
POINTS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
air control point 	Is the symbol oriented to a terrain feature?						
	Is there no repetition of numbers?						
	Is the symbol drawn as a circle?						
	Are the letters ACP in the symbol?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
ammunition transfer point 	Is the symbol oriented to a terrain feature?						
	A circle with the Class V symbol and ATP?						
	Is the symbol in the BSA?						
	Is the location close to the MSR?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
checkpoint 	Is the symbol oriented to a terrain feature?						
	Is the symbol drawn as a square and triangle?						
	Is the triangle pointing to the terrain feature?						
	Is there no repetition of numbers?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
collecting point 	Is the symbol oriented to a terrain feature?						
	Drawn as a circle with type designation?						
	Is the symbol located behind the FLOT?						
	Is the symbol near the MSR?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
communications check-point 	Is the symbol oriented to a terrain feature?						
	Is there no repetition of numbers?						
	Is the symbol drawn as a circle?						
	Are the letters CCP in the symbol?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
contact point 	Is the symbol oriented to a terrain feature?						
	Is the symbol drawn as a square?						
	Is the terrain feature designated by a line?						
	Is there no repetition of numbers?						
	TOTAL SCORE						


ROTATION:		TASK FORCE:		DATE:			
POINTS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
coordinating point 	Is the symbol oriented to a terrain feature? Is the symbol drawn as a circle with an x? Is the terrain feature at the cross of the x? Located on boundaries between units? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
decontamination point 	Is the symbol oriented to a terrain feature? Drawn as a circle with designation? Is the chemical symbol in the circle? Is there no repetition of designations? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
forward arming and refueling point 	Is the area oriented on terrain features? Are the letters FARP in the symbol? Located between FLOT and CSS area of BSA? Covered from direct fire and observation? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
linkup point 	Is the symbol oriented to a terrain feature? Is the symbol drawn as a square and triangle? Is there a dot and number in the symbol? Is there no repetition of numbers? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
passage point 	Is the symbol oriented to a terrain feature? Is the symbol drawn as a square and triangle? Letters PP and designation in the symbol? Is there no repetition of designations? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
point of departure 	Is the symbol oriented to a terrain feature? Is the symbol on the line of departure? Is the symbol drawn as a square and triangle? Are the letters PD in the symbol? TOTAL SCORE						







ROTATION:		TASK FORCE:		DATE:		
POINTS						
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
pop-up point	Is the symbol oriented to a terrain feature?					
	Is the symbol drawn as a circle and a line?					
	Is the aviation symbol in the circle?					
	Is the designation PUP next to the symbol?					
	TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
rally point	Is the symbol oriented to a terrain feature?					
	Is the symbol drawn as a circle and arrow?					
	Is the arrow pointing to the terrain feature?					
	RALLY and a designation in the circle?					
	TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
release point	Is the symbol oriented to a route?					
	Is the symbol drawn as a square and triangle?					
	Is the triangle pointing to a terrain feature?					
	Are the letters RP in the symbol?					
	TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
start point	Is the symbol oriented to a route?					
	Is the symbol drawn as a square and triangle?					
	Is the triangle pointing to a terrain feature?					
	Are the letters SP in the symbol?					
	TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
strong point	Is the symbol oriented to a terrain feature?					
	Is there no repetition of numbers?					
	Drawn as a closed area with radial lines?					
	Are the letters SP in the symbol?					
	TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY	
traffic control point	Is the symbol oriented to a route?					
	Is the symbol at key locations along the route?					
	Drawn as a square, triangle and lightpost?					
	Is the triangle pointing to the key location?					
	TOTAL SCORE					





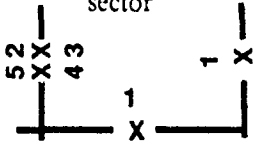
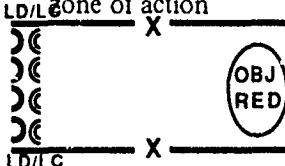
ROTATION:		TASK FORCE:		DATE:			
LINES							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
airhead line 	Boundaries oriented around the airhead? Are there coordination points between units? Unit sizes and designations present? Is the airhead enclosed by the symbol? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
boundary 	Is the boundary oriented to terrain features? Is the symbol drawn as a solid line? Is the unit size located on the line? Are the unit designations present? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
bridgehead line 	Broken line with BRIDGEHEAD LINE? Is the symbol on the enemy side of the river? Are objectives included within the symbol? Does the symbol have a designation? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
coordinated fire line 	Is the line oriented to terrain features? Is the symbol drawn as a broken black line? Is the establishing HQ above the line? Is the effective DTG below the line? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
final coordination line 	Is the line oriented to terrain features? Is the line close to the objective? Line designated by FINAL CL at both ends? Easily recognizable on the ground? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
fire support coordination line 	Is the line oriented to terrain features? Is the symbol drawn as a solid black line? FSCL and establishing HQ above the line? Is the DTG effective below the line? TOTAL SCORE						

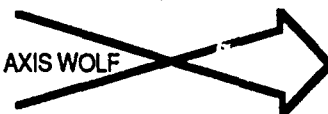

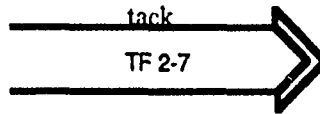
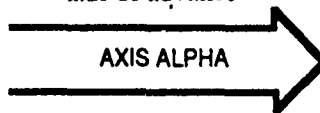
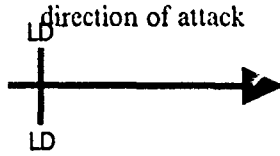

ROTATION:		TASK FORCE:		DATE:			
LINES							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
forward edge of the battle area 	Is the line oriented to terrain features? Is the line bounded by coordination points? Is FEBA at each end of the line? Is the symbol drawn as a solid black line? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
forward line of own troops 	Is the line drawn as a series of arcs? Are the arcs open to the friendly side? Does the line cross the entire sector? Is FLOT at each end of the line? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
holding line 	Solid line with HOLDING LINE? Enclosed area on enemy side of the river? Area precludes direct or observed fires? Does the symbol have a designation? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
light line 	Is the line oriented to a route? Does the line cross the entire sector? Is LL written at each end of the line? Is the symbol drawn as a solid line? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
advance 	Is the line oriented to terrain features? Does the line cross the entire sector? Is LOA written at each end of the line? Is the symbol drawn as a solid line? TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
line of contact 	Is the line drawn as two series of arcs? Are the single arcs open to the friendly side? Are the double arcs open to the enemy side? Are there coordination points at each end? TOTAL SCORE						


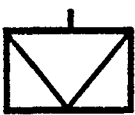
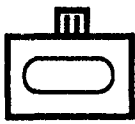
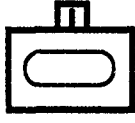

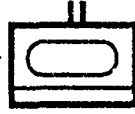
ROTATION:		TASK FORCE:		DATE:			
LINES							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
lines of communication 	Is the line drawn along a route? Arrows to indicate traffic direction? Do the lines connect forces and/or bases? If alternating traffic, ALT on the line?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
line of departure 	Is the line oriented to terrain features? Is the symbol drawn as a solid black line? Is LD at each end of the line? Does the line cross the entire sector?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
line of departure is the line of contact 	Is the line drawn as two series of arcs? Are the single arcs open to the friendly side? Are the double arcs open to the enemy side? Is LD LC at each end of the line?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
phase line 	Is the line oriented to terrain features? Is PL (designation) at both ends of the line? Is there no repetition of designations? Does the line cross the entire sector?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
probable line of deployment 	Is the line oriented to terrain features? Is the symbol drawn as a broken line? Is PLD at each end of the line? Is the line close to the objective?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
restrictive fire line 	Is the line oriented to terrain features? Is the symbol drawn as a solid red line? RFL and establishing HQ above the line? Is the DTG effective below the line?						
TOTAL SCORE							







ROTATION:		TASK FORCE:		DATE:			
AREAS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
airspace coordination area <div style="border: 1px solid black; padding: 5px; width: fit-content;"> ACA 23d Mech Div MIN ALT: 500 MAX ALT: 3000 EFF: 281400ZAPR 282030ZAPR </div>	Is the area drawn as a red rectangle? Are the letters ACA in the symbol? Is the establishing HQ in the symbol? Are the effective DTGs in the symbol?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
assault objective <div style="border: 1px solid black; border-radius: 50%; padding: 10px; text-align: center; width: 100px; margin: 10px auto;"> OBJ ? </div>	Is the symbol drawn as an enclosed area? Is OBJ (designation) in the symbol? Is the area recognizable on the ground? Is there no repetitions of designations?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
assault position <div style="border: 1px solid black; border-radius: 50%; padding: 10px; text-align: center; width: 100px; margin: 10px auto;"> ASLT PSN DELTA </div>	Is the symbol drawn as an enclosed area? Is ASLT PSN (designation) in the symbol? Is the area between the LD and the objective? Is it covered and concealed from the enemy?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
assembly area <div style="border: 1px solid black; border-radius: 50%; padding: 10px; text-align: center; width: 100px; margin: 10px auto;"> AA PUMA 3  28 </div>	Is the symbol drawn as an enclosed area? Is AA (designation) in the symbol? Unit locations specified within the symbol? Is the area oriented to terrain features?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
attack position <div style="border: 1px solid black; border-radius: 50%; padding: 10px; text-align: center; width: 100px; margin: 10px auto;"> ATK 1 </div>	Is the symbol drawn as an enclosed area? Is the symbol the last position behind LD? Is the symbol oriented to terrain features? Is ATK (designation) in the symbol?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
battle position <div style="border: 1px solid black; border-radius: 50%; padding: 10px; text-align: center; width: 100px; margin: 10px auto;"> BP 8 </div>	Is the symbol oriented to terrain features? Does the symbol have a unit size designation? Is BP (designation) in the symbol? Is there no repetition of designations?						
TOTAL SCORE							





ROTATION:		TASK FORCE:		DATE:			
AREAS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
brigade support area 	Is the area oriented on terrain features?						
	Are the letters BSA in the symbol?						
	CS and CSS units identified in the area?						
	Is the BSA behind the FEBA?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
division support area 	Is the area oriented on terrain features?						
	Are the letters DSA in the symbol?						
	CS and CSS units identified in the area?						
	Located behind the brigade rear boundaries?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
drop zone 	Is the symbol drawn as an enclosed area?						
	Is DZ (designation) in the symbol?						
	Is there no repetition of designations?						
	Is the area oriented to the terrain?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
engagement area 	Is the symbol drawn as an enclosed area?						
	Is EA (designation) in the symbol?						
	Is there no repetition of designations?						
	Oriented to the terrain and or TRP?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
free fire area 	Is the area oriented on terrain features?						
	Are the letters FFA in the symbol?						
	Is the establishing HQ in the symbol?						
	Are the effective DTGs in the symbol?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
landing zone 	Is the symbol drawn as an enclosed area?						
	Is LZ (designation) in the symbol?						
	Is there no repetition of designations?						
	Is the area oriented to the terrain?						
	TOTAL SCORE						



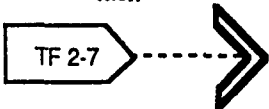



ROTATION:		TASK FORCE:		DATE:	
AREAS					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
no-fire area 	Is the area outlined in red with diagonals? Are the letters NFA in the symbol? Is the establishing HQ in the symbol? Are the effective DTGs in the symbol? TOTAL SCORE				
SYMBOL	COMPONENTS	Go	No	SCR	QTY
objective 	Is the symbol drawn as an enclosed area? Is OBJ (designation) in the symbol? Is the area recognizable on the ground? Is there no repetitions of designations? TOTAL SCORE				
SYMBOL	COMPONENTS	Go	No	SCR	QTY
pickup zone 	Is the symbol drawn as an enclosed area? Is PZ (designation) in the symbol? Is there no repetition of designations? Is the area oriented to the terrain? TOTAL SCORE				
SYMBOL	COMPONENTS	Go	No	SCR	QTY
restrictive fire area 	Is the area outlined in red? Are the letters RFA in the symbol? Is the establishing HQ in the symbol? Are the effective DTGs in the symbol? TOTAL SCORE				
SYMBOL	COMPONENTS	Go	No	SCR	QTY
sector 	Boundaries oriented to terrain features? Are there lateral boundaries? Is there a rear boundary? Is the unit size and designation present? TOTAL SCORE				
SYMBOL	COMPONENTS	Go	No	SCR	QTY
zone of action 	Is there a LD LC? Are there lateral boundaries? Is there an objective? Is the unit size and designation present? TOTAL SCORE				




ROTATION:		TASK FORCE:		DATE:	
ROUTES					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
air axis of advance 	Drawn as a twisted axis of advance? Is the symbol oriented to the terrain? Does the symbol have a designation? Is there no repetition of designations?				
TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
air corridor 	Does the route connect ACPs and/or CCPs? Headings given for both directions of travel? CORRIDOR (designation) on segments? Is there no repetition of designations?				
TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
axis of advance for main attack 	Does the symbol have a double arrowhead? Is the axis marked with a designation? Is the axis oriented to the terrain? Is there no repetition of designations?				
TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
axis of advance 	Does the symbol have a single arrowhead? Is the axis marked with a designation? Is the axis oriented to the terrain? Is there no repetition of designations?				
TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
direction of attack 	Is the symbol drawn from the LD? Is the symbol drawn as a single arrow? Does the symbol point towards the objective? Is the symbol not labeled?				
TOTAL SCORE					
SYMBOL	COMPONENTS	Go	No	SCR	QTY
route 	Is the symbol drawn as a solid line? Is the symbol oriented to the terrain? RT (designation) on the symbol? Does the symbol have an RP, SP?				
TOTAL SCORE					

ROTATION:		TASK FORCE:		DATE:			
UNIT SYMBOLS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
air defense section / platoon	Rectangle, arc, and weapon symbol?						
<div style="display: flex; align-items: center; justify-content: center;"> 1  B/14 </div>	Platoon / section size indicator on top?						
	Unit designations on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
antiarmor company / team	Is the symbol drawn as a rectangle and a v?						
<div style="display: flex; align-items: center; justify-content: center;"> E  1-58 </div>	Company / team size indicator on top?						
	Unit designations on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
armor battalion task force	Is the symbol drawn as a rectangle and tread?						
<div style="display: flex; align-items: center; justify-content: center;"> 2  69 </div>	Battalion / task force size indicator on top?						
	Unit designations on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
armor company / team	Is the symbol drawn as a rectangle and tread?						
<div style="display: flex; align-items: center; justify-content: center;"> C  1-70 </div>	Company / team size indicator on top?						
	Unit designations on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
artillery battery (self-propelled)	drawn as a rectangle, tread, and ball?						
<div style="display: flex; align-items: center; justify-content: center;"> A  2-10 </div>	Company / team size indicator on top?						
	Unit designations on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
battalion trains	Rectangle, unit type, horizontal line?						
<div style="display: flex; align-items: center; justify-content: center;"> CBT  2-69 </div>	Battalion Task Force indicator on top?						
	Unit designations and type on the sides?						
	Is unit location specified correctly?						
TOTAL SCORE							

ROTATION:		TASK FORCE:		DATE:			
UNIT SYMBOLS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
enemy unit 	Double rectangle, unit type in the symbol? Unit size indicator on top? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
1 32 MRB							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
chemical platoon / section 	Rectangle, crossed beakers, and SMOKE? Platoon / section size indicator on top? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
1 ASMK							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
mechanized infantry battal- ion task force 	Rectangle, diagonals, vertical and tread? Battalion task force size indicator on top? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
1 58							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
mechanized infantry com- pany / team 	Rectangle, diagonals, vertical and tread? Company team size indicator on top? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
A 1-58							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
mortar platoon 	Rectangle, tread, diagonals, and dot? Platoon size indicator on top of symbol? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
MTR 3-7							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
scout platoon 	Rectangle, tread, and diagonal? Platoon size indicator on top of symbol? Unit designations on the sides? Is unit location specified correctly? TOTAL SCORE						
SCT 2-22							

ROTTATION:		TASK FORCE:		DATE:			
CROSSINGS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
assault 	Is the symbol used for a river crossing?						
	Are both sides of the river bracketed?						
	Is the location identifiable on the ground?						
	Designated Assault Crossing?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
ford 	Is the symbol used with a water obstacle?						
	Is the symbol drawn as a broken arrow?						
	Is the location identifiable on the ground?						
	Does the arrow indicate direction of travel?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
gap 	Is the symbol drawn as facing brackets?						
	Does the symbol break the obstacle?						
	Is the location identifiable on the ground?						
	Does the symbol have a designation?						
	TOTAL SCORE						
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
lane 	Drawn as a line with inward arrowheads?						
	Does the symbol cross the obstacle?						
	Is the location identifiable on the ground?						
	Does the symbol have a designation?						

ROTATION:		TASK FORCE:		DATE:			
BATTLEFIELD MISSIONS							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
airborne force	Drawn as a twisted axis of advance?						
	Does it include airborne unit symbol?						
	Does the symbol have a designation?						
	Is there no repetition of designations?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
air assault	Drawn as a twisted axis of advance?						
	Does it include helicopter symbol?						
	Does the symbol have a designation?						
	Is there no repetition of designations?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
follow and assume main attack	Does the symbol have a double arrowhead?						
	Does the symbol follow an attack axis?						
	Unit designation in the symbol tail?						
	Symbol drawn as a broken line?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
follow and support mission	Does the symbol have a single arrowhead?						
	Does the symbol follow an attack axis?						
	Unit designation in the symbol tail?						
	Symbol drawn as a solid line?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
observation post	Drawn as a triangle?						
	Does the symbol have a designation?						
	Is the symbol oriented to a terrain feature?						
	Is there no repetition of designations?						
TOTAL SCORE							
SYMBOL	COMPONENTS	Go	No	SCR	QTY		
reconnaissance	Drawn as zig-zag arrows?						
	Do the arrows point to identifiable terrain?						
	Is the reconnaissance unit symbol included?						
	Is the unit symbol drawn correctly?						
TOTAL SCORE							

ROTATION:		TASK FORCE:		DATE:			
BATTLEFIELD MISSIONS							
SYMBOL		COMPONENTS		Go	No	SCR	QTY
smoke 		Drawn as an enclosed area? Is the symbol designated SMOKE? Is the symbol oriented to the terrain? Is the date and time present?					
		TOTAL SCORE					
SYMBOL		COMPONENTS		Go	No	SCR	QTY
support by fire 		Drawn as a bracket with an arrow? Does the symbol have a designation? Does the arrow specify direction of fire? Is the symbol oriented to the terrain?					
		TOTAL SCORE					
SYMBOL		COMPONENTS		Go	No	SCR	QTY
withdrawal 		Drawn as a battle position or unit symbol? Arrow pointing away from the enemy? Does the arrow specify the withdrawal route? Is the route oriented to the terrain?					
		TOTAL SCORE					

LIST OF REFERENCES

1. Department of the Army, *Field Manual 101-5-1, Operational Terms and Symbols* Washington, D.C., 21 October 1985.
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3. Army Research Institute, Presidio of Monterey, *ARI-CTC Archive & Research Center Workshop Notebook*, ARI-POM, Monterey, California, April 1990.
4. Department of the Army, *Field Manual 100-5, Operations* Washington, D.C., 5 May 1986.
5. Gibbons, J.D., *Nonparametric Methods for Quantitative Analysis*, 2d ed., American Sciences Press, 1985.
6. *SAS User's Guide: Statistics*, 5th ed, SAS Institute Inc., Cary, North Carolina, 1985.

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